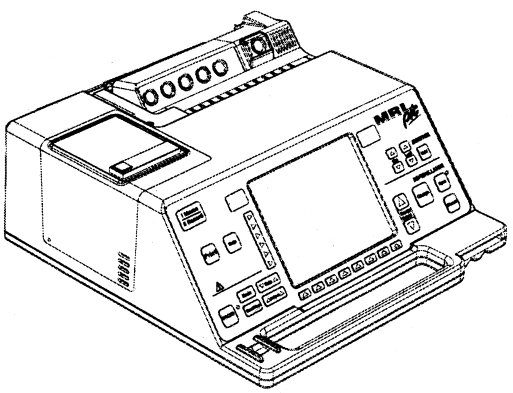
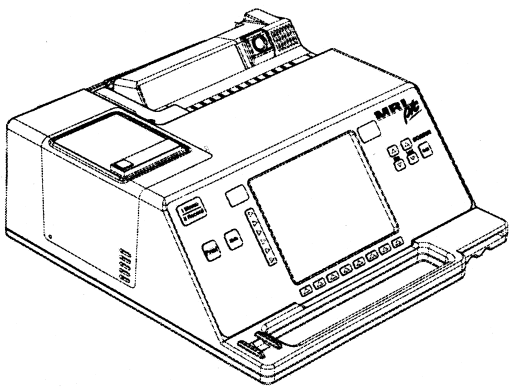
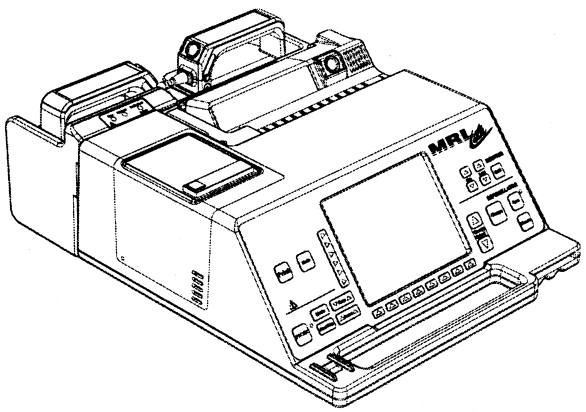
Service Manual



MRL Pic System™



MRL PIC Monitor™



MRL Lite™

P.N. 991011 Rev C

Portable Intensive Care System

SERVICE INSTRUCTION MANUAL

Models: PIC, PIC 2, PIC 2H
PIC Monitor
MRL Lite, MRL Lite 2, MRL Lite 2H

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MRL Part Number 991011

Foreword

This manual is intended to provide information for the proper servicing of the MRL PIC.

DO NOT ATTEMPT TO USE THIS EQUIPMENT WITHOUT THOROUGHLY READING AND UNDERSTANDING THESE INSTRUCTIONS.

User's Responsibility

The user is required to be trained in basic monitoring, vital signs assessment and emergency cardiac care. The user should be completely knowledgeable of the information in the User Instruction Manual. As with all other electronic patient care monitors, good clinical judgment should be used when operating the MRL PIC.

User must save all shipping containers and packaging materials. When shipping the PIC System and accessories for calibration, service, or upgrades, the original shipping containers and packaging materials must be used.

Manufacturer's Responsibility

Medical Research Laboratories, Inc. (MRL), is responsible for the safety, reliability and performance of the MRL Portable Intensive Care System, only if the following three conditions are met:

- Assembly operations, extensions, readjustments, modifications or repairs are carried out by persons authorized by MRL.
- The electrical installation of the relevant room complies with the appropriate requirements.
- The PIC equipment is used in accordance with the instructions for use.

To ensure patient safety and proper operation, use only MRL - authorized parts and accessories.

FDA Medical Device Registration

The FDA Safe Medical Device Act stipulates that each end-user is required under penalty of law, to register with the manufacturer all information pertinent to each medical device.

Please fill out the attached FDA Medical Device Registration postcard and return it promptly to MRL. This card must be filled in and returned within 30 days of product delivery.

If the medical device is transferred from your possession, you must notify MRL of the new registration information.

Please contact MRL (800/462-0777) if you have any questions regarding this notice.

Declaration of Conformity

Manufacturer: Medical Research Laboratories, Inc.
1000 Asbury Drive
Buffalo Grove, IL 60089
USA
Phone (847) 520-0300
Fax (847) 520-0303

Response Medical Equipment, Ltd.
Bracken House - Battlebrook
Chipping Campden GL55 6JX
Gloucestershire, United Kingdom
Phone 11-44-1-386-841926
Fax 11-44-1-386-841230

declares that the CE-marked product

Product Name: PIC (Portable Intensive Care)

Base Units	
971009	5 lead, EL display
971013	5 lead, Color display
971026	12 lead, EL display
971027	12 lead, color display
971042	5 lead, LCD display
971044	5 lead, without defib

Options			
971021	SpO_2	971023	Data recording
971074		971024	Data playback
971016	CO_2	971073	RS-232
971001	NIBP	971019	FAX
971005	Voice Memo	971104	Battery charger
971008	SAED	971029	Integral mains supply
971017	IBP		

Device Type: Defibrillator / External Transcutaneous Pacemaker / Multifunction Monitor

complies with Council Directive 93/42/EEC (Medical Device Directive) of 14 June 1993 class IIb Annex II

Standards

General: IS0 9001
EN 46001

Safety: IEC 601-1 / EN 60601-1 Class I, Continuous operation
Type BF (with external paddles) or CF (with internal paddles)
IEC 601-1-4 / EN 60601-1-4
IEC 601-2-4 / EN 60601-2-4
IEC 601-2-25 / EN60601-2-25
IEC 601-2-27 / EN 60601-2-27
IEC 601-2-30 / EN 60601-2-30
IEC 601-2-34 / EN 60601-2-34
IEC 1441 / EN1441
EN 865
EN 475

EMC: IEC 601-1-2 / EN 60601-1-2

J. Orlinsky

Date January 23, 2003

Joel Orlinsky
Director of Q. A. and Regulatory Affairs

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CHAPTER 1: SAFETY INFORMATION

This chapter provides informaton on the safe operation of the Portable Intensive Care (PIC) System.

Chapter Overview:

- *Symbols and Icons 1.2*
- *General Precautions 1.5*
- *Monitoring Precautions 1.7*
- *Defibrillator Precautions 1.8*
- *External Pacing Precautions 1.10*
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- *CO_2 Precautions 1.17*

Symbols and Icons

Symbols

Graphical symbols, letter symbols and signs listed below may be found on the PIC System and accessories distributed by MRL. Please note the use of these symbols for safe and proper use of the equipment.

Alternating current

For indoor use only (on battery charger only)

Attention, consult accompanying documents

Negative input terminal

Auxiliary power operation

Positive input terminal

Caution, high voltage

Power off

Dangerous voltage

Power on

Defibrillator protected, type BF patient connection

Recycle battery

Defibrillator protected, type CF patient connection

Protective earth (ground)

Earth (ground)

Defibrillator discharge button

Release

The symbols listed below may by found throughout this manual.

Warning: Hazards or unsafe practices that could result in severe personal injury or death.

Caution: Hazards or unsafe practices that could result in minor personal injury or product damage.

Note: Points of particular interest for more efficient or convenient operation.

Icons

Graphical and text icons listed below may be found on the display of the PIC System during operation.

	Alarm off		Check chart recorder
	Alarm on		Auto heart rate undetermined
	Alarm lower limit set		Auto heart rate set at 60 BPM
	Alarm upper limit set		Modulated outputv
	Automatic HR Alarm set		Mute
	Alarm - push to disable		One volt output
	Animated recording icon		QRS beeper off
	Battery full		QRS beeper on
	Battery low warning		Volume level
	Battery (partially depleted)		Supervisor menu locked
	Auxiliary power		Supervisor menu unlock
	Blood pressure pump 1		Notch filter On
	Blood pressure pump 2		Analyze
	Calibration Pulse		Internal log
	12-Lead		Card Review card usage

Invasive Blood Pressure

Carbon Dioxide On

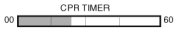
Analyze 12-lead

Carbon Dioxide Off

Card Review/12-lead Next Page

Resets to patient 001 in card review

12-lead save function



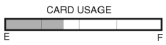
SAED CPR timer

Fax/modem

Latching connection

Card Review/12-lead printer

Do Not Sterilize



Card Review card usage and location

Press here to unlatch

General Precautions

The MRL PIC is intended for use by trained, authorized medical personnel who are familiar with basic monitoring, vital signs assessment, and emergency cardiac care. The MRL PIC is also intended for use by physicians at the scene of an emergency or in a hospital emergency room.

Federal (USA) law restricts this device to sale by or on the order of a physician.

Any authorized person using the MRL PIC should be completely knowledgeable of the information in the User Instruction Manual.

Accessories

Use only authorized MRL accessories listed in the Introduction chapter of this manual. Use of unauthorized accessories may cause the device to operate improperly and provide false measurements.

Sterilization

Do Not attempt to sterilize any accessory or equipment part except internal defibrillator electrodes and the internal paddle cable. Refer to chapter 16 of the PIC User Instruction Manual for more information.

Battery Care

Proper care and maintenance of the MRL batteries is important to insure continuous operation during patient care. If the batteries are not maintained properly, loss of power during patient care could result, affecting patient care. Always have a fully charged battery pack available as a back-up.

Dropped or Damaged

If this device has been dropped or damaged in any way, refer the device to qualified service personnel for verification of performance and/or servicing.

Ingress of Liquids

To achieve the specified level of protection against spilled or splashed liquids, thoroughly dry all exposed surfaces of this device prior to operation or connections to mains power.

Electrical Shock

Hazard: Do not use the MRL PIC if it has been immersed in a liquid or if liquid has spilled on it. Do not clean the MRL PIC with alcohol, ketone, or any flammable agent. Do not autoclave the MRL PIC. Conductive parts of electrodes and connectors, for applied parts, should not contact other conductive parts including earth.

Electrical Shock (Internal)

Hazard: This device does not contain any user-serviceable parts. Do not remove instrument covers or attempt to repair the MRL PIC System. Refer servicing to qualified personnel.

Electrodes (Disposable)

When obtaining a new supply of disposable electrodes for monitoring, defibrillation or pacing, verify that they will properly connect to the existing MRL cables prior to putting in service. Do not use if gel is dry.

Energy Discharge

Hazard: The MRL PIC can deliver 360 joules of electrical energy. If this electrical energy is not discharged properly, as described in the User Instruction Manual, the electrical energy could cause personal injury or death to the operator or bystander.

Expiration Date

Always verify expiration dates on dated items such as disposable defibrillation or pacing pads, monitoring electrodes and battery packs. If the expiration date has passed, replace the disposable items immediately.

Ferromagnetic Equipment

Biomedical equipment and accessories, such as ECG electrodes, cables, and oximeter probes contain ferromagnetic materials. Ferromagnetic equipment must not be used in the presence of high magnetic fields created by magnetic resonance imaging (MRI) equipment.

The large magnetic fields generated by an MRI device can attract ferromagnetic equipment with an extremely violent force, which could cause serious personal injury or death to persons between the equipment and the MRI device.

Labels

Observe all PRECAUTION and WARNING labels on the MRL PIC System and Quick Charger/Conditioner.

Operating Near Oxygen

Hazard: Care should be exercised when operating the MRL PIC and MRL Quick Charger/Conditioner in the presence of oxygen sources (such as near bag-valve-mask devices or ventilators), flammable gases or anesthetics. These environments can produce fire or explosion hazards.

Patient Physical Harm

Place the PIC System, accessories and cables in a position where they cannot harm the patient should they fall. Keep all cables and hoses away from patient's neck.

Performance

The MRL PIC System may not meet performance specifications if stored, transported, or used outside the specified storage or operating environmental range limits.

Treatment Summary Log

To prevent incorrect trending data from being printed, clear the Treatment Summary Log from the Recorder-Log menu prior to use on a new patient.

Monitoring Precautions

- **WARNING: PACEMAKER PATIENTS**. The MRL PIC includes a pacemaker rejection circuit. The following warning is in accordance with the disclosure requirement of AAMI Standard EC13-3.1.2.1 (8): The rate meter may continue to count the pacemaker rate during some occurrences of cardiac arrest or some arrhythmias. Do not rely upon the heart rate meter alarms to assess the patient's condition. Keep pacemaker patients under close surveillance. Pacemaker pulses of the type specified in AAMI EC13-1992, section 3.1.4, are detected at amplitudes greater than ± 20mV and rejected by the heart rate display. However, pacemaker pulses that are superimposed on the ECG at very low amplitudes may be counted by the heart rate display.

  Note: This warning is an AAMI requirement that applies to all ECG monitors, regardless of make or model.

- Use only MRL patient cables. Other cables can produce excessive artifact, causing an inability to interpret the ECG.
- Use only ECG electrodes that meet the AAMI standard for electrode performance (AAMI EC-12). Use of electrodes not meeting this AAMI standard could cause the ECG trace recovery after defibrillation to be significantly delayed.
- The type of surface electrode and the technique used in applying the electrodes are major factors in determining the quality of the signal obtained. Use high-quality, silver-silver chloride electrodes. These electrodes are designed to provide excellent baseline stability, provide rapid recovery from defibrillation, and minimize artifacts from patient movement.
- When attempting to interpret subtle ECG changes (ST segments, etc.), use only the diagnostic frequency response mode. Other frequency response settings may cause misinterpretation of the patient's ECG. See Frequency Response in chapter 13 of the PIC User Instruction Manual for more information.
- Excessive artifact can result due to improper skin preparation of the electrode sites. Follow skin preparation instructions in chapter 4 of the PIC User Instruction Manual.
- Do not operate the PIC System in conjunction with electrocautery or diathermy equipment. Such equipment, as well as equipment that emits strong radio frequency signals, can cause electrical interference and distort the ECG signal displayed by the monitor, thereby preventing accurate rhythm analysis.

- Do not operate the PIC in close proximity to any other monitor with respiration measurements. The two devices could affect the respiration accuracy.
- Any external connection to the 1V or MOD outputs must comply with clause 19 of IEC 601-1 for leakage current and must not exceed 450 mA.
- Shock Hazard: Use of accessories, other than those specified in the operating instructions, may adversely affect patient leakage currents.
- Certain line-isolation monitors may cause interference on the ECG display and may inhibit heart rate alarms.

Defibrillator Precautions

- The MRL PIC can deliver 360 joules of electrical energy. If this electrical energy is not discharged properly, as described in the User Instruction Manual, the electrical energy could cause personal injury or death to the operator or bystander.
- The operator and all other people must stand clear of the patient, the bed and all conductive surfaces (that are in contact with the patient) during defibrillation. The electrical energy delivered to the patient could also be delivered to any other person who is in contact with the patient or the conductive surface.
- Do not use the defibrillator in the presence of oxygen sources (such as near bag-valve-mask devices or ventilators), flammable gases or anesthetics. These environments can produce fire or explosion hazards.

- **WARNING: Never** position defibrillator paddles very close to or over ECG electrodes or jewlery. Severe burns may result from improper contact of defibrillator paddles. Before using defibirllator, consult operating instructions for proper procedures.
- After a synchronized cardioversion, the SYNC mode may be cleared after each shock or disarm. The user may have to reselect (press) the SYNC switch after each synchronized cardioversion shock performed on a patient. The PIC can be configured in the Supervisor-Defibrillation Set-up menu to remain in the SYNC mode after each synchronized cardioversion.

- Synchronized cardioversion can be performed in the paddle monitoring mode. However, it is possible that artifact can be produced by the moving paddles, which could cause the defibrillator to trigger on the artifact. It is recommended that monitoring in leads I, II or III be used during synchronized cardioversion. Paddle monitoring should not be used for elective cardioversions procedures.
- To avoid stress to the defibrillator or the tester, never attempt to repeatedly charge and discharge the defibrillator in rapid succession. If a need for repetitive testing arises, allow a waiting period of at least 2 minutes for every third discharge.
- Monitoring ECG through the paddles may result in inaccurate heart rate display due to artifact.
- In the SYNC mode the defibrillator will not discharge without a command
- (R-Wave) signal indicated by a SYNC marker, flashing SYNC indicator and an audible beep if the R-wave beeper is enabled.
- Do not use the defibrillator if excessive condensation is visible on the device. Wipe only the outside with a damp cloth.
- Use only MRL-approved disposable defibrillation and pacing pads and cables.
- Defibrillator paddles should be kept clean and dry when not in use. When preparing electrodes and during defibrillation procedures, extreme care should be exercised to prevent gel or any conductive material from forming a contact between the operator and the paddles. Do not allow gel or any other conductive material to form an electrical bridge between the defibrillator electrodes or to the monitoring electrodes. Electrical arcing and/or patient burns could occur during defibrillation. Arcing and patient burns could prevent sufficient energy delivery to the patient.

- **WARNING**: If conductive gel forms a continuous path between the defibrillator electrodes, delivered energy may be dramatically reduced to zero. In this case, reposition the electrodes to eliminate the shunting path before attempting additional shocks.
- Improper defibrillation technique can cause skin burns. To limit possible skin burns, use only MRL defibrillation gel on paddles, insure the gel covers the entire paddle surface and press firmly against patient's chest.

- Disposable defibrillation electrodes must be used in accordance with the manufacturer's instructions. Do not use expired, dry electrodes or reuse disposable electrodes, as improper patient contact may result in patient burns and inability of the device to function properly.
- The device contains an automatic disarm of the capacitor bank. If the operator has not delivered the charge to a patient or test load, an internal timer will disarm the capacitor bank 1 minute in manual mode and 30 seconds in SAED Basic or SAED Basic+ mode after the ready charge signal. The ready charge signal is indicated by a continuous audible tone and the energy availability graph displayed on the monitor.
- If a new energy level is selected after the charge button is pushed and while the defibrillator is charging, defibrillator will automatically charge to the new energy selection. The CHARGE button need not be pressed again to select the new energy level.
- Disconnect from the patient any medical electronic device that is not labeled "defibrillation protected."
- Before charging the defibrillator, verify that the energy selected on the display is the desired output.
- Some erythema of the skin and/or minor burns may occur during defibrillation. Use proper defibrillation techniques, as outlined in the User Instruction Manual, to minimize erythema/burns.

External Pacing Precautions

- Defibrillation will take priority over external pacing. Should the defibrillator be charged during the administration of external pacing, the pacer will automatically be turned off and the defibrillator will charge to the selected energy.
- Transcutaneous pacing should not be used to treat V FIB (ventricular fibrillation). In cases of V FIB, immediate defibrillation is advised.
- Transcutaneous pacing may cause discomfort ranging from mild to severe, depending on the patient's tolerance level, muscle contractions and electrode placement. In certain cases, discomfort may be decreased by slightly relocating the pacing pads.

- It is important to monitor the patient closely to verify that both mechanical and electrical capture are occurring. Electrical capture can be verified by observing the presence of a large ectopic beat after the pacing pulse is delivered. The size and morphology of the beat are dependent on the patient. In some instances the beat may appear as a relatively normal looking QRS pulse. Mechanical capture can be verified by checking for signs of increased blood flow i.e., reddening of the skin, palpable pulses, increased blood pressure, etc. (See chapter 8 of the PIC User Information Manual). Continuously observe the patient during pacing administration, to insure capture retention. Do not leave the patient unattended when administering external pacing therapy.
- Some erythema of the skin and/or minor burns may occur under the pacing electrodes in some patients. For prolonged periods of pacing (>4 hours), periodically inspecting the skin beneath the electrodes (when patient's condition allows) is recommended. Discontinue external pacing if the skin is affected and if another form of pacing is available.
- Disposable defibrillation/pacing electrodes must be used in accordance with the manufacturer's instructions. Do not use expired, dry electrodes or reuse disposable electrodes, as improper patient contact may result in patient burns and inability of the device to function properly.
- The pacing rate determination can be adversely affected by artifact. If the patient's pulse and the heart rate display are significantly different, external pacing pulses may not be delivered when required.

- **WARNING: PACEMAKER PATIENTS**. The MRL PIC includes a pacemaker rejection circuit. The following warning is in accordance with the disclosure requirement of AAMI Standard EC-13-3.1.2.1 (8): The rate meter may continue to count the pacemaker rate during some occurrences of cardiac arrest or some arrhythmias. Do not rely upon the heart rate meter alarms to assess the patient's condition. Keep pacemaker patients under close surveillance. Note: This warning is an AAMI requirement that applies to all ECG monitors, regardless of make or model.
- Artifact and ECG noise can make R-wave detection unreliable, affecting the HR meter and the demand mode pacing rate. Always observe the patient closely during pacing operations. Consider using asynchronous pacing mode if a reliable ECG trace is unobtainable.

Pulse Oximeter Precautions

- Keep the MRL finger probe clean and dry.
- SpO_2 measurements may be affected by certain patient conditions: severe right heart failure, tricuspid regurgitation or obstructed venous return.
- SpO_2 measurements may be affected when using intravascular dyes, in extreme vasoconstriction or hypovolemia or under conditions where there is no pulsating arterial vascular bed.
- SpO_2 measurements may be affected in the presence of strong EMI fields, electrosurgical devices, IR lamps, bright lights, improperly applied sensors; the use of non-MRL sensors, or damaged sensors; in patients with smoke inhalation, or carbon monoxide poisoning, or with patient movement.
- Tissue damage can result if sensors are applied incorrectly, or left in the same location for an extended period of time. Move sensor every 4 hours to reduce possibility of tissue damage.
- Do not use any oximetry sensors during MRI scanning. MRI procedures can cause conducted current to flow through the sensors, causing patient burns.
- Do not apply SpO_2 sensor to the same limb that has an NIBP cuff. The SpO_2 alarm may sound when the arterial circulation is cut off during NIBP measurements, and may affect SpO_2 measurements.

- **WARNING**: In some instances, such as obstructed airway, the patient's breathing attempts may not produce any air exchange. These breathing attempts can still produce chest size changes, creating impedance changes, which can be detected by the respiration detector. It is best to use the pulse oximeter whenever monitoring the respirations to accurately depict the patient's respiratory condition.

Non-Invasive Blood Pressure Precautions

- Only a physician can interpret pressure measurements.
- Blood pressure measurement results may be affected by the position of the patient, his or her physiological condition and other factors.
- Substitution of a component different from that supplied by MRL (e.g., cuff, hoses, etc...) may result in measurement error. Use only MRL cuffs and hoses.
- Do not use a blood pressure cuff on the limb being used for IV infusion or for SpO_2 monitoring.
- Accurate pressure readings may not be achieved on a person experiencing arrhythmias, shaking, convulsions or seizures. Medication may also affect pressure readings. The correct-size cuff is essential for accurate blood pressure readings.
- Blood pressure hoses must be free of obstructions and crimps.
- If the patient's cuff is not at heart level, an error in measurement may result.
- When monitoring blood pressure at frequent intervals, observe the cuffed extremity of the patient for signs of impeded blood flow.

- **WARNING**: THIS DEVICE IS NOT APPROVED FOR USE ON NEO-NATAL PATIENTS.
- Do not monitor one patient's NIBP while monitoring another patient's ECG.
- Blood pressure measurement may be inaccurate if taken while accelerating or decelerating in a moving vehicle.
- If an NIBP measurement result is questionable or "motion" indication is displayed, repeat the measurement. If the repeated measurement result is still questionable, use another blood pressure measurement method.
- Do not use the NIBP on cardiopulmonary bypass patients.

Battery Precautions

- Use only MRL SmartPak or MRL SuperPac batteries in the MRL PIC. Use of any other battery can damage the MRL PIC and not provide sufficient power, inhibiting patient care.
- If the Low Battery indication occurs at any time during operation, immediately replace the battery pack with a battery pack known to be fully charged. Always have a fully charged battery pack available as a back-up.
- Due to the critical nature of all batteries, replacement of the MRL batteries is recommended at 24-month intervals.
- Proper care and maintenance of the MRL batteries is important to ensure continuous operation during patient care. If the batteries are not maintained properly, loss of power during patient care could result, affecting patient care.
- The battery packs contain materials such as stainless steel, cadmium and nickel, which can be recycled. They must be disposed of properly. Consult local authorities for proper disposal.

Charger Precautions

- Charge only MRL SmartPak or MRL SuperPac batteries in the MRL Quick Charger/ Conditioner. Charging any other battery can cause damage to the MRL Quick Charger.
- Do not insert objects into or block the charger's ventilation ports.
- When testing the defibrillator on the charger's defibrillation output tester, ensure that the paddle surface is positioned properly in the paddle test well. Do not use gel during this test, and ensure that the paddle surface is not contacting the metal charger frame. When discharging the paddles into the tester, press the paddles firmly into the test well to prevent pitting the paddle surfaces.
- Only test MRL defibrillators on the charger's defibrillation output tester. Testing other brands of defibrillators will damage the charger's defibrillation output tester.
- Do not take charger or paddle holder apart or attempt to repair it yourself.
- The MRL charger should not be used in the presence of flammable anesthetics or materials.
- If the charger has been dropped or shows visible signs of abuse, refer device to qualified service personnel for verification of proper operation.
- Do not immerse the charger or expose it to water or other liquids.
- Wipe only the outside with a damp cloth.
- Tighten clamp onto power cord to prevent its accidental removal.
- Unplug the charger prior to changing the fuse.
- Use only the MRL Quick Charger to power the MRL PIC System from an auxiliary power source.
- Do not use the MRL Quick Charger to power any non-MRL devices.
- A depleted battery could increase defibrillator charge times.
- It is recommended that a fully charged battery be inserted in the PIC System even when operating on auxiliary power.

- **Note**: The MRL PIC System will operate from an auxiliary power source without a battery inserted or if the inserted battery is depleted. However, under these circumstances, defibrillator charge time will be slightly longer (10 seconds typical, 15 sec. maximum).

SAED Precautions

- **WARNING: Cardiac Pacemakers**. The presence of an internal cardiac pacemaker may adversely affect analysis results. If it is known, or suspected, that the patient is fitted with a cardiac pacemaker, follow your own locally-established procedure for dealing with defibrillation of such patients.
- The PIC, in SAED mode, should only be applied to victims of cardiac arrest who exhibit unconsciousness, absence of breathing, and absence of pulse.
- Excessive motion may affect analysis results. ECG analysis should not be performed when the patient is being moved. Stop all patient movement and do not touch patient when the ECG analysis is in process. Take precautions to eliminate sources of motion or artifact before monitoring in SAED mode.
- SAED mode automatically selects 200, 300, 360J for defibrillation energy. Use of SAED mode on patients weighing less than 80 lbs. may increase the risk of myocardial tissue damage.

IBP Precautions

- To insure compatability and electrical safety, accessory pressure sensors should comply with ANSI/AAMI BP-22 and IEC 601-2-34 for IBP or ANSI/AAMI NS28 for ICP
- Follow instructions supplied with any accessory pressure sensor regarding calibration and removal of trapped air.
- Avoid touching metal parts of any transducer while it is in contact with the patient.
- Do not reuse any components that are labeled for single use only.
- Transducers should be rated to withstand an accidental drop of at least a meter onto a hard surface.
- Transducers that are subject to immersion in liquids should be rated as watertight.

CO_2 Precautions

- Do not use CO_2 sensor during MRI scanning. MRI procedures can permanently damage the CO_2 sensor.
- CO_2/$ETCO_2$ measurements may be affected by the presence of interfering gases or vapors. Do not use on a patient being administered oxygen or nitrous oxide.
- Use only MRL CO_2 sensors and adapters.
- Do not reuse airway adapters that are labeled for single patient use.
- Prior to using airway adapter check for lodged obstructions. After attaching, check the sensor for proper placement of the sensor.
- If using the CO_2 monitor for extended critical care, replace the airway adapter every 24 hours or when it becomes occlued.
- Do not use with patients with a low tidal volume, such as patients younger than 3 years of age or weighing less than 22 pounds, or patients with a respiration rate greater than or equal to 60 breaths per minute.
- Accuracy is based upon 1 atmospheric pressure and no residual CO_2 gas left in the sensor from previous expiration. The CO_2 trace will be displayed as if that is the case.

CHAPTER 2: GENERAL INFORMATION

This chapter introduces the MRL Portable Intensive Care (PIC) System. It contains a product overview, a general description and equipment setup, summary of operation procedures for servicing the unit, an explanation of the part numbering system, and a list of available options and accessories system. The chapter concludes with the technical specifications.

Chapter Overview:

- *Product Overview. 2.2*
- *General Description 2.2*
- *PIC System Interfaces 2.3*
- *PIC System Controls and Indicators 2.5*
- *PIC System Modes 2.7*
- *Initial Installation Evaluation. 2.9*
- *Equipment Setup 2.11*
- *Summary of Operations 2.18*
- *Part Numbering System 2.21*
- *Options and Accessories 2.22*
- *Technical Specifications 2.24*

CAUTION! Federal law restricts this device to use by or on the order of a physician.

NOTE: See the PIC User Instruction Manual for more detailed operation procedures, when using this system on a patient).

NOTE: The disassembly, performance verification, and adjustment procedures described in this manual are intended to be performed by qualified service technicians using the recommended tools and equipment.

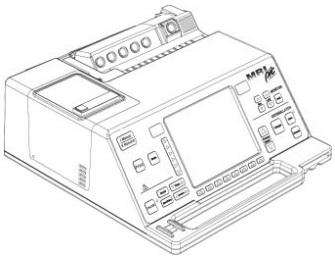
Product Overview

The MRL PIC System is an extremely flexible device that incorporates an ECG monitor, defibrillator (manual or semi-automated), external pacer, pulse oximeter, and a non-invasive blood pressure/respiration monitor. The PIC System's small and lightweight design makes it ideal for transport situations or for use in and out of the hospital.

General Description

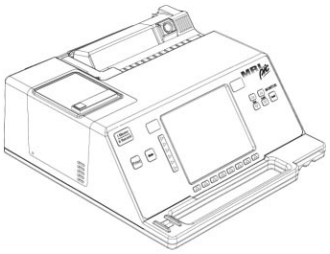
Refer to the following User's Manuals for instructions on the operation of the corresponding MRL product: PIC System, PIC Monitor (991010), and Lite (991022). All MRL PIC products include a 6.4" VGA display and an annotating chart recorder. An integral paddle tray/AC supply, shown on the MRL Lite, is optional on all units.

MRL PIC System™



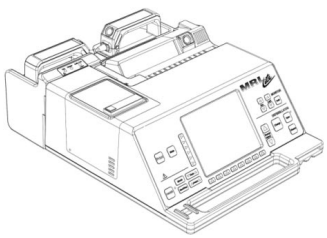
The MRL PIC System is a multi-parameter Monitor/ Defibrillator/Pacer. Standard functions for the PIC are ECG, DEFIB, PACER, and RESP. Upgradeable options include 12-Lead, NIBP, SpO_2, TEMP, AED, CO_2, IBP, Voice Memo, Fax, and Data Record/Review. Display options include EL, Color TFT, and Mono LCD. Acceptable batteries include the SmartPak Plus™ and SuperPac™.

MRL PIC Monitor™



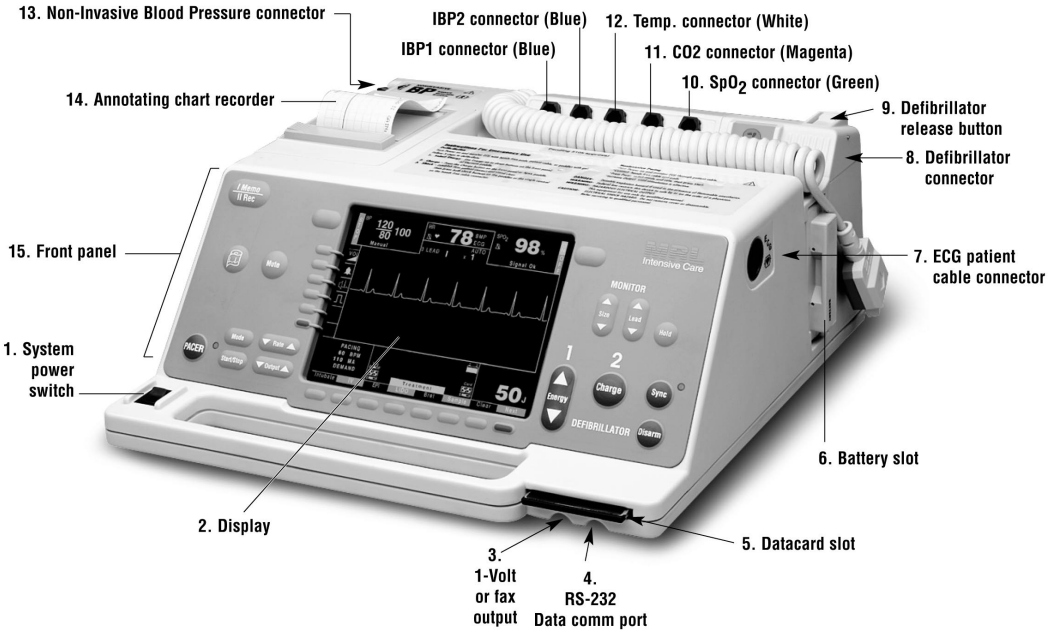
The MRL PIC Monitor standard functions are ECG and RESP. Upgradeable options include 12-Lead, NIBP, SpO_2, TEMP, CO_2, and IBP. The PIC Monitor uses a monochrome LCD display. Acceptable batteries include the SmartPak™, SmartPak Plus™+, and SuperPac™.

MRL Lite™



The MRL Lite is a Monitor/Defibrillator Pacer. Standard functions for the Lite are ECG and DEFIB. Upgradeable options include Pacing and Advisory. The Lite has a monochrome LCD display. Acceptable batteries include the SmartPak™, SmartPak Plus™, and SuperPac™. A PCMCIA data card is not available for the Lite.

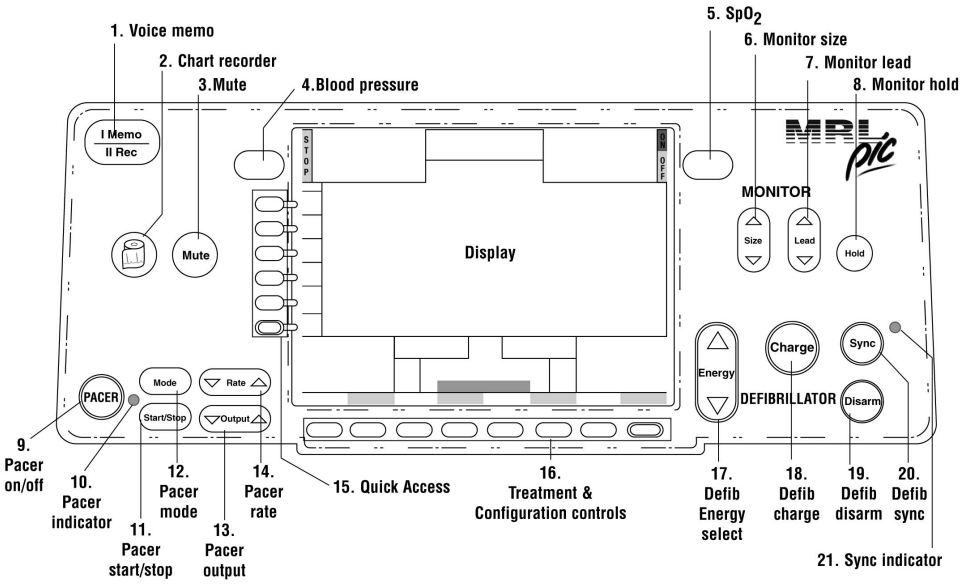
PIC System Interfaces



1.	**System power switch**	Switch for main system power.
2.	**Display**	6.5" screen that displays ECG and other parameter information.
3.	**1-Volt output (optional)**	Provides an analog output scaled to 1V output for a 1mV input signal. Used for telemetry radio transmissions.
	Fax output (optional)	Provides fax transmission capability on 12-Lead PIC's.
4.	**RS-232 Data com port**	Part of download of internal log to a computer or external device.
5.	**Datacard slot**	For system upgrades, data recording and configuring.
6.	**Battery slot**	Accepts MRL SmartPak Plus or MRL SuperPac batteries.
7.	**ECG Patient Cable Connector**	Accepts 3-lead, 5-lead, 12-lead MRL patient cables. *Note: Only use MRL patient cables. Excessive artifact could result.*
8.	**Defibrillator connector**	Allows connection of external paddles, hands-free adapter or internal paddles.

9.	**Defibrillator release button**	Unlocks the defibrillation connector from the defibrillator, to allow removal of external paddles, hands-free adapter or internal paddles. *Note: When sliding defibrillation connector, make sure the release button clicks into place and returns to its up position.*
10.	**SpO_2 connector (optional)**	Allows connection of MRL pulse oximeter sensors.
11.	**$C0_2$ Connector**	Allows connection of MRL CO_2 cable or cable adapter.
12.	**Temp connector (optional)**	Allows connection of MRL temperature probe.
13.	**NIBP connector (optional)**	Allows connection of MRL non-invasive blood pressure cuffs.
14.	**Annotating Chart recorder**	Accepts standard 50 mm paper.
15.	**Front panel**	Control panel with buttons for PIC System operation.

PIC System Controls and Indicators



1.	**Voice memo**	Allows documentation of audio messages.
2.	**Chart recorder**	Activates and deactivates the chart recorder.
3.	**Mute**	Pressing the MUTE button once causes all audio alarms and tones to be muted for 90 seconds (except defibrillator charge tones).
4.	**Blood pressure (optional)**	Starts or stops cuff inflation.
5.	**SpO_2 (optional)**	Turns on or off the pulse oximeter.
6.	**Size**	Selects ECG trace sizes.
7.	**Lead**	Selects ECG input source.
8.	**Hold**	Freezes the traces on the display.
9.	**Pacer on/off**	Turns on/off pacer circuit.
10.	**Pacer indicator**	Automatically illuminates during pacing activity.
11.	**Pacer start/stop**	Delivers pacing stimulus to the patient or pauses delivering pacing stimulus to the patient.
12.	**Pacer mode**	Changes pacing mode from DEMAND to ASYNC.
13.	**Pacer output**	Selects pacing output current.
14.	**Pacer rate**	Selects pacing output rate.
15.	**Quick access**	Initiates menu functions appearing adjacent to each button on the display when PIC System is on.

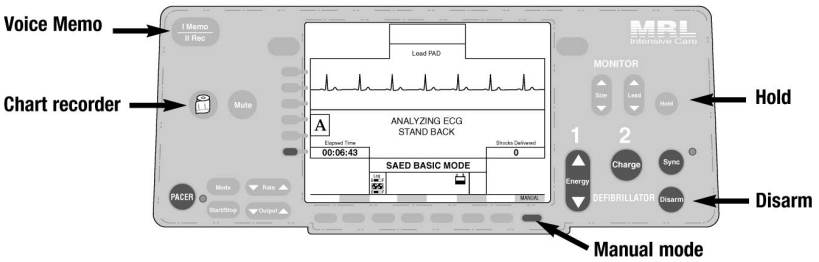
16.	**Treatment/Configuration controls**	Treatment allows documentation of specific treatment summary events and Configuration allows access to menu windows.
17.	**Defib energy select**	Selects defibrillation energy levels.
18.	**Defib charge**	Initiates defibrillator to charge to selected energy.
19.	**Defib disarm**	Disarms charged defibrillator internally.
20.	**Defib sync**	Activates the synchronization mode.
21.	**Sync indicator**	Light that indicates sync activation.

PIC System Modes

When the Semi-Automatic Defibrillation (SAED) option has been installed, the PIC can be configured to power up in one of three modes; SAED Basic, SAED Basic +, Manual defibrillation mode. Each mode has a unique display and some controls and indicators may be deactivated (Refer to Defibrillator Controls and Indicators section). The SAED Basic + mode has been designed to all those BLS personnel who have completed additional training to assess the patients vital signs (NIBP and Pulse Ox). In the SAED Basic + mode the operator would be able to operate the Pulse Oximeter and the Non-Invasive Blood Pressure. In the SAED Basic mode these parameters have been disabled to simplify operations.

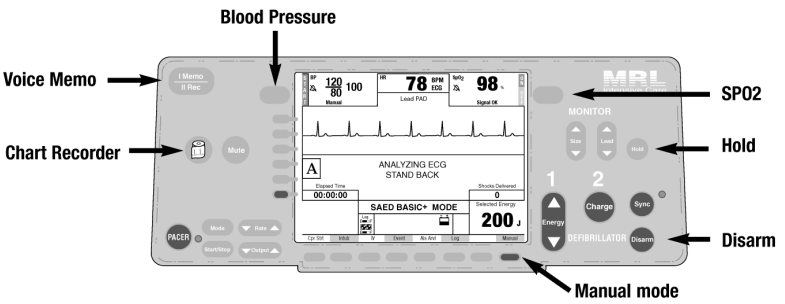
SAED Basic Mode

If the PIC has been configured to power-up in the SAED Basic mode, only the voice memo (supervisor configurable), chart recorder, hold and disarm controls will be active. Below is an example of the active controls and display.



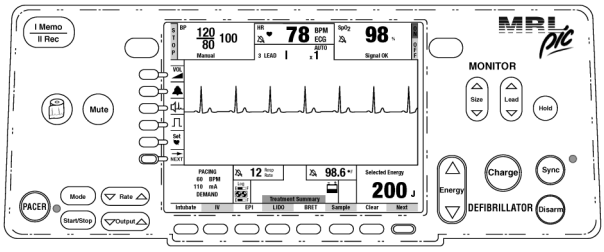
SAED Basic + Mode

If the PIC has been configured to power-up in the SAED Basic + mode, the voice memo (supervisor configurable), chart recorder, hold, blood pressure, SpO_2, treatment summary and disarm controls will be active. Below is an example of the active controls and display.



Manual Mode

If the PIC has been configured to power-up in the Manual Defibrillation mode, all the controls will be active. Below is an example of the display.



Initial Installation Evaluation

To determine the initial installation condition of the MRL PIC System after shipment, follow the simple steps below.

Unpacking Instructions

Visually inspect the carton and the equipment for any signs of damage or mishandling (carton perforations, cuts or dents, bent or collapsed corners, or broken carton seal). If damaged, contact MRL immediately.

BEFORE PROCEEDING FOLLOW STEPS 1-2-3

1. Open and carefully unpack each carton.
2. Examine the instrument and accessories for signs of damage.
3. Check the packing list to determine that all accessories have been received. Save all packing materials, invoicing and any other paperwork.

TO DETERMINE INITIAL INSTALLATION CONDITION

In order to ensure that the device is running properly after shipping, follow the instructions below.

1. Connect defibrillator multipurpose hands-free adapter. Charge all batteries prior to first use.
3. Insert a fully charged MRL SmartPak battery into the battery slot, or use the auxiliary power cable from the MRL Quick Charger or use the AC power cord from the paddle holder.
4. Press the PIC System power switch to the on position.
5. The PIC System will perform a series of self-tests and a “Self-Test Passed” message will be printed on the chart recorder paper.

6. Installed options will appear on the display after the self-test has been completed. Compare the installed options on the display with the options you checked off on previous page.
7. To set time and date, see Chapter 3.
8. Perform daily/shift test, see Chapter 5.
9. To review default menu settings, see Chapter 3.

If you note any discrepancies, please contact MRL. You will need to provide your model and serial numbers.

Equipment Setup

NOTE: The battery shipped with the MRL product is not charged. To charge the battery and prepare the MRL product for normal use, follow the procedures below.

Inserting the Battery

To insert the battery, find the battery slot on the right side of the PIC and slide the battery in, connectors first. Press the battery firmly into the slot to assure proper connection of all 4 contact points on the battery.

Charging Battery Packs with Optional Paddle Tray/Charger

The MRL Quick Charger/Conditioner charges 3 standard MRL battery packs simultaneously in approximately 4 hours.

1. To initiate a battery pack charge cycle, insert the MRL battery into any of the 3 numbered slots in the front of the charger. When the battery is firmly seated into the contacts at the back of the slot, the yellow light behind the slot illuminates, indicating that the battery is being charged. This light remains on for the duration of the charging cycle. When the battery is fully charged, the yellow light flashes to indicate it is ready for use.
2. A completely discharged battery SmartPak Plus pack requires approximately 4 hours to recharge, and a MRL SuperPac requires approximately 8 to 10 hours. Charging time varies depending on battery capacity and state of charge. Deeply discharged batteries and those with higher capacity take longer to charge; partially discharged batteries and those with lower capacity require less time to charge.

NOTE: Charging battery packs at temperatures above 30°C (86°F) prolongs the charging time and may result in a gradual decline in battery capacity.

3. If a fully charged battery is inserted into the charger, it will be charged for a short period of time while the charger determines its state of charge. When it is determined that the battery is fully charged, the yellow light will flash. This process may take several minutes.
4. MRL SmartPaks contain NiCad batteries, which tend to lose charge capacity if they are repeatedly charged after not being fully discharged or are charged at high temperatures. In order to counteract these cumulative deteriorating effects, periodically exercise the SmartPak by deeply discharging it in the Reconditioning Slot (Slot #3) before recharging. See the reconditioning schedule later in this chapter.

5. Slot #3 on the MRL Battery Charger has dual charging and reconditioning capabilities. To use slot #3 only to charge a battery pack, insert the MRL battery into the slot. When the battery has been firmly seated into the contacts at the back of the slot, the yellow light behind the slot will illuminate indicating that the battery is being charged. When the battery is fully charged, the yellow light will flash to indicate it is ready for use.

Conditioning Battery Packs (important)

To initiate a battery conditioning cycle:

1. Insert the battery into Slot #3.
2. Press the red push button switch on the top of the charger behind Slot #3.
3. The red reconditioning light next to the push button will light, indicating that the battery pack is being exercised.

At the end of the exercise period the charger automatically begins a normal charge cycle. The yellow battery light illuminates, indicating that the battery is charging. When the yellow battery light begins to flash, the conditioning cycle is complete. The red conditioning light remains on until the battery is removed to serve as a reminder that the battery has been exercised. If an additional conditioning cycle is desired, press the push button again. Leave the battery in the charger until the yellow battery light begins to flash again.

The time required for the discharge cycle to be completed varies depending on battery capacity and state of charge. A fully charged SmartPak Plus battery with normal capacity requires approximately 8 hours to discharge in the reconditioning slot, and a high capacity SuperPac battery requires 18 hours. Partially discharged batteries require less time. After the discharge portion of the reconditioning cycle has been completed, the battery pack will undergo a normal charging cycle.

Reconditioning with Paddle Tray/ Charger

To recondition the battery in the unit using the paddle tray/charger option, perform the battery capacity test and reconditioning procedure in Chapter 5.

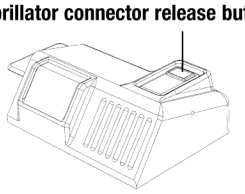
Connecting the Patient Cable

Make sure the connector on the cable is firmly pushed into the patient connector interface.

Connecting the Defibrillator Adapter

Slide the adapter inward along the guide plate on the defibrillator interface. Make sure the adapter is pushed snug against the plastic housing to assure a solid connection. Make sure that the release button clicks into place and returns to its up position.

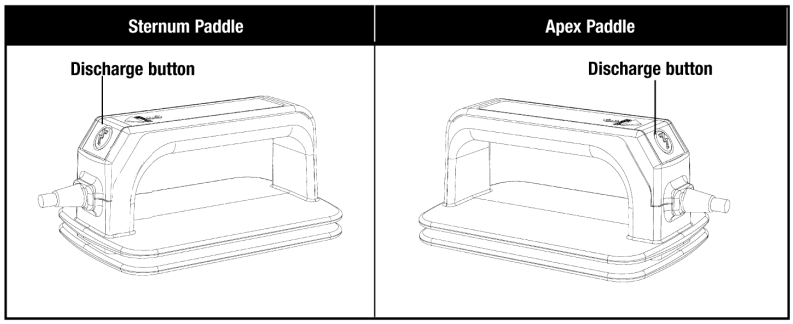
Defibrillator Connector



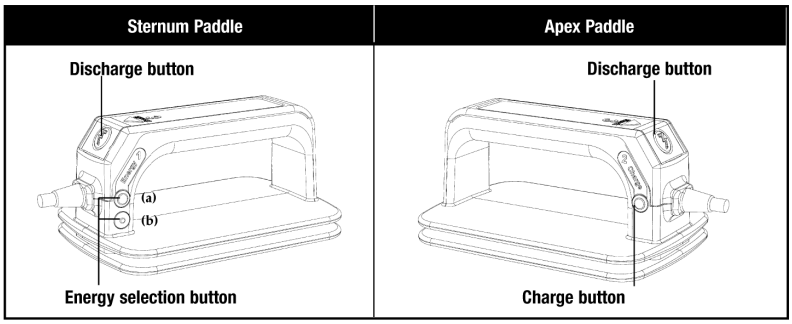
Note: When sliding the defibrillator adapter on, make sure the release button clicks into place and returns to its up position.

Fig. 1

Standard Adult Paddles

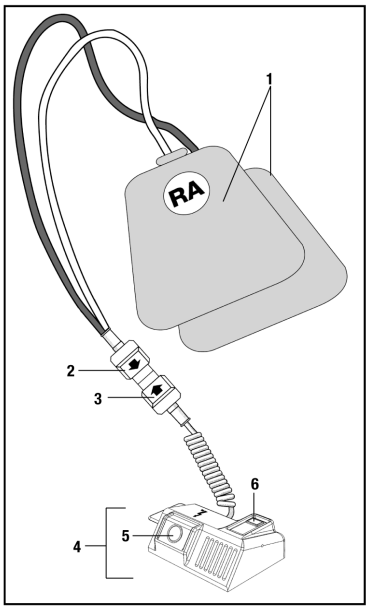


Standard Adult Paddles (optional)



Defibrillation Hands-Free Pads and Internal Paddles

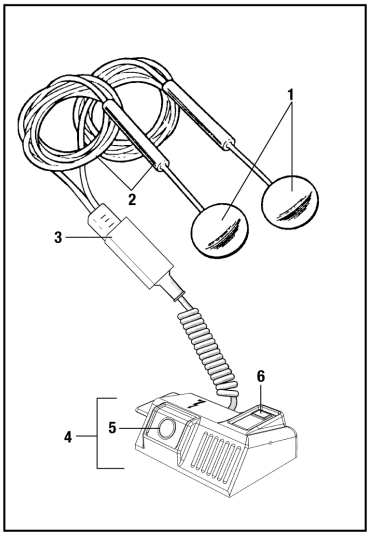
Multipurpose Hands-Free Adapter and Electrodes (optional)



1.	**Multipurpose Pads**	
2.	**Pad Connector**	Connects to patient connector.
3.	**Patient Connector**	Accepts disposable monitoring / defibrillation /non-invasive pacing pads. (MRL part # 001789)
4.	**Multipurpose Hands-Free Adapter**	
5.	**Shock Button**	Hands-free discharge button
6.	**Adapter Release Button**	Unlocks the adapter connector from the defibrillator to allow removal.

NOTE: When sliding the multipurpose hands-free adapter on make sure the release button clicks into place and returns to its up position.

Internal Paddle (IP) Set (optional)



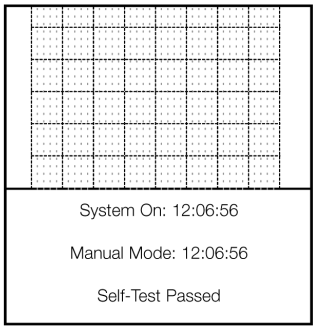
1.	**Removable Electrodes**	
2.	**Cable and Handle Assembly**	Allows connection of internal paddle electrodes.
3.	**IP Connector**	Allows cable and handle assembly to be removed for sterilization
4.	**IP Adapter**	Provides the interface between PIC and internal paddles. Do not sterilize this adapter.
5.	**IP Discharge Button**	
6.	**IP Adapter Release Button**	Unlocks the adapter connector from the defibrillator to allow removal.

NOTE: When sliding the IP hands-free adapter on make sure the release button clicks into place and returns to its up position.

Turning On the PIC

To turn the unit on and print a self test:

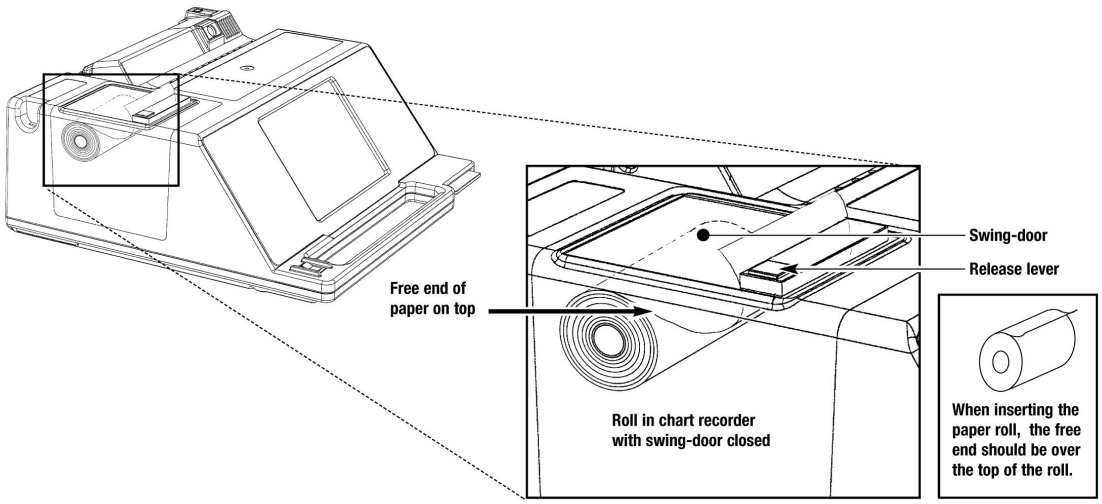
1. Press button to begin printing.The unit performs a self-test and prints out a test strip.



2. Press button again to stop printing.

Loading Recording Paper

The check recorder icon () will appear in the message window of the display when the chart paper is empty or the chart recorder door is not closed properly.



NOTE: The low paper indicator is signified by a black or red strip at the top of the chart recorder paper. When the indicator appears, approximately 8 feet of paper is left on the roll.

LOADING CHART PAPER

1. Open the door by pushing on the release lever located on the side of the chart recorder.
2. Remove the empty spool core. Place the new roll of ECG paper with the free end of the paper on top of the roll. Insert the new spool until it snaps onto the spool retaining arms. The spool should be positioned so the inside or shiny side of the paper contacts the thermal array print head. The spool should feed paper from the top.
3. Pull out approximately 2”-3” of paper and bring the free end of the paper around to the front of the swing-out door; then completely close the door.
4. With the power switch on, press the chart recorder button and allow the paper to feed through the roller automatically.

NOTE: If *icon flashes on the display, the paper is probably not moving freely through the slot in the door or the door is not completely shut. Open the door and make sure the paper moves freely through the slot after closing the door again.*

If the chart recorder runs, but nothing is printed, the paper is in backwards. Rotate the spool so the inside of the paper contacts the print head.

Summary of Operations

CAUTION: The Summary of Operations should be used as a reference only by those who have already read the User Instruction Manual. Please read the User Instruction Manual completely before using the PIC System.

System Setup

a. Press **POWER** switch to OFF.

b. Connect appropriate options and accessory equipment.

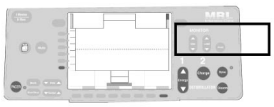
c. Install charged battery or auxiliary power source.

d. Press **POWER** switch to ON.

e. Clear log if the graph indicates a previous patient's events are in the log.

f. Verify that the configuration menus are set appropriately.

ECG Monitoring



a. Connect ECG patient cable, multipurpose hands-free adapter or paddles to the PIC System.

b. Prep patient's skin and connect electrodes to patient.

c. Select appropriate **LEAD**.

d. Adjust **SIZE** as necessary.

Defibrillating

a. Monitor patient's ECG with the patient cable, multipurpose hands-free adapter or paddles.

b. Apply gel to paddles or apply Multipurpose electrodes to patient.

c. Select energy by pressing the **ENERGY** up/down buttons.

d. Press **CHARGE** button on front panel or on apex paddle (deluxe paddles).

e. After the defibrillator charges to the selected energy (a continuous charge tone will be heard), visually and verbally clear the patient.

f. Place the paddles firmly on the patient's chest.

g. To discharge the defibrillator, press both **DISCHARGE** buttons on the paddles or press the **DISCHARGE** button on the multipurpose hands-free adapter.

Non-Invasive Pacing (optional)

a. Monitor patient's ECG with the ECG patient cable. Set lead to I, II, or III.

b. Apply multipurpose pads to patient as illustrated on package.

c. Connect multipurpose pads to multipurpose hands-free adapter.

d. Press the **PACER** button to turn on pacer.

e. Press the **MODE** button to select either DEMAND or ASYNC modes.

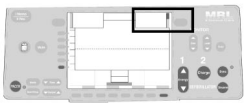
f. Press the **RATE** button to select the desired rate.

g. Press the **START/STOP** button to initiate pacing.

h. Press the **OUTPUT** up arrow to increase the pacing output current, until capture is obtained.

NOTE: If the defibrillator is charged, the pacer will automatically turn off.

Monitoring SpO_2

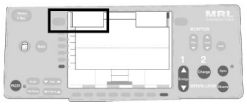


a. Attach appropriate SpO_2 sensor to the patient and to the PIC System.

b. Press the **BUTTON** next to the SpO_2 window to turn on the SpO_2 monitor.

c. To display the patient's plethysmograph, select Pleth in the display - Trace menu.

Monitoring NIBP



a. Attach the appropriate-size cuff and hose to the PIC System.

b. Apply the cuff snugly to the limb of the patient.

c. Select the NIBP mode (manual or automatic) from the NIBP configuration menu. In AUTO mode, select desired time interval.

d. Press the **BUTTON** next to NIBP window to START NIBP measurement.

e. During a measurement, press the button next to NIBP window to stop the NIBP measurement. The cuff will deflate.

CO_2 (optional)

1. Attach the CO_2 cable to the PIC System.
2. Attach the disposable airway adapter to the CO_2 Sensor.
3. Attach the airway adapter to the intubation tube.
4. Press **CO_2** button in the Quick Access menu to begin monitoring CO_2. A Capnography trace will be displayed.

12-Lead (optional)

1. Connect 12-Lead ECG patient cable to the PIC System.
2. Prep patient's skin and connect electrodes to patient to monitor ECG, select lead and adjust size as necessary

NOTE: To acquire a 10 second, 12-Lead ECG sample perform steps 3-5.

3. Press the **12** button (A) on the quick access window.
4. Press the **ACQUIRE** button (B) to enter you into the Active 12-Lead Mode.
5. After 10 seconds, the PIC System will prompt the user that is has acquisition. A snapshot and real-time window will appear, each showing leads I, II, and III. The Quick Access window will have also changed to display Analysis, Save, Fax, Print, Page, and Back icons.

SAED (optional)

1. Assess Patient. Confirm the patient exhibits:
   -Unconsciousness
   -Absence of breathing
   -Absence of pulse
2. Press POWER switch to ON. Ensure Self-Test passed and battery icon is not LOW.
3. Remove or loosen patient's clothing if necessary for application of pads.
4. Check expiration date of the pads. Do not use pads that have expired. Remove disposable multipurpose pads from packaging. Use MRL Multipurpose electrodes model 001789 for adult patients only. Remove protective cover from pads and apply the pads to the patient. Apply the RA pad to the patient's right side – to the side of the breast bone and below the collar bone. Apply the LL pad over the patient's ribs to the left of the nipple.
5. Follow display messages and voice prompts.

Part Numbering System

PIC System Part Numbering

MRL uses a part numbering system that allows both the user and service technician to understand what type of unit and installed options are in each PIC System.

9 7 1 0 ____ ____ ____ ____ ___ ____ ___ ____ ____ ___ ____

X X Color SpO2 CO2 NIBP IBP VM/Adv Rec/Rev 12 Ld Opt Lang.

XX: 09 = PIC - 5 lead, EL Display
13 = PIC - 5LD, Color TFT Display
26 = PIC - 12LD, EL Display
27 = PIC - 12LD, Color TFT Display
42 = PIC - 5LD, Mono LCD Display

Color: Y = (Yellow)
G = (Gray)

SpO2: S = Installed (971002)
0 = Not Installed

CO2: C = Installed (971016)

NIBP: B = Installed (971001)

IBP: 1 = One channel, 2 = 2 channels (971017)

VM/Adv: V = Voice Memo - 971005
A = SAED - 971008 & 971005 (Included Voice Memo)

Rec/Rev: R = Data Record - 971023
P = Data Record and Review (Playback) - 971023 & 971024
D = Data Comm Package - 971073, RS-232, Record (971023), and Review (971024)

12LD Options: Available on 12 LD Units only (0 if not a 12 Lead Unit)
F = Faxing - 971019-EEC (Europe), 971019-US (USA), 971019-AUS (Australia)
A = 12-Lead Analysis - 971018 (Not yet available)
B = Faxing and Analysis - 971019 & 971018 (Not yet available)

Language: E = English (Language code also designates accessory part numbers)
S = Spanish (Europe)
G = German
F = French
I = Italian
P = Portuguese
U = UK
A = Australia
M = Mexico (Spanish North America)
T = South Africa

Options and Accessories

The following options and accessories are available for the PIC. For future reference, check off which options and accessories you currently have from the information provided on the packing list. Should you want to upgrade your system or purchase additional accessories, please contact MRL at (800) 462-0777.

Options Installed

❑	971074	Pulse oximeter	❑ ❑	971023 971024	Data Card Review/Record
❑	971001	NIBP and Temperature	❑	971016	CO_2
❑	971005	Voice Memo™	❑	971073	Data Comm
❑	971008	SAED	❑	971019	Fax
❑	12-Lead (optional)		❑	12-Lead Interpretive Analysis	

Accessories

❑	971106	Adult paddles	❑	001790	3-lead patient cable
❑	971108	Adult deluxe paddles	❑	001794	3-lead patient cable w/intnl color code
❑	001537	Pediatric adapters (set)	❑	001795	5-lead patient cable
❑	971107	Hands-free defibrillator adapter	❑	001796	5-lead patient cable w/intnl color code
❑	900322	Hands-free defibrillator tester	❑	001720	Bitrode limb electrodes
❑	971125	Internal paddle adapter	❑	001797	12 Lead patient cable
❑	001515	Internal paddles 25mm (1") (set)	❑	001958	12 Lead patient cable, IEC
❑	001516	Internal paddles 50mm (2") (set)	❑	001798	3 Lead patient cable for 12 Lead
❑	001517	Internal paddles 76mm (3") (set)	❑	001948	3 Lead patient cable for 12 Lead, IEC
❑	570312	Internal paddle cable	❑	980128	Cardiac demonstrator
❑	001636	MRL SmartPak battery	❑	001938	Fax output cable
❑	001638	MRL SmartPak Plus battery	❑	900241	Cellular phone adapter
❑	001647	MRL SuperPac	❑	001726	ECG electrodes
❑	900223	Carrying case	❑	002051	Defibrillator gel
❑	900224	External paddle pouch	❑	001788	Multipurpose electrodes (adult)
❑	900225	Hands-free pouch	❑	001927	Disposable skin temperature sensor

❑	971104	MRL Quick Charger	❑ 001781	Multipurpose electrodes (child)
❑	001739	Recorder paper	❑ 002052	KLEAN TRACE™ conductive spray
❑	001955	SpO_2 adapter cable	❑ 001930	Adult disposable tympanic temp sensor
❑	00211	Finger probe, reusable, adult	❑ 001931	Pediatric disposable tympanic temp sensor
❑	001911	NIBP adult thigh cuff	❑ 001932	Reusable 10ft extension cable for all disposable temp sensors
❑	001915	NIBP adult large arm cuff	❑ 001933	Calibration check plug
❑	001912	NIBP adult arm cuff	❑ 001950	CO_2 airway adapter -Qty 5
❑	001913	NIBP child cuff	❑ 001951	CO_2 airway adapter - Qty 50
❑	001914	NIBP infant cuff	❑ 001954	CO_2 adapter
❑	001922	NIBP cuff hose, 6ft.	❑ 001934	CO_2 sensor
❑	001923	NIBP cuff hose, 10ft	❑ 001910	SmartView software and manua
❑	001942	NIBP adult disposable cuff	❑ 980136	CardioLog memory card – 4mb
❑	001943	NIBP thigh disposable cuff	❑ 980137	CardioLog memory card – 8mb
❑	001944	NIBP hose for use with disposable cuffs	❑ 980138	CardioLog memory card – 16mb
❑	001945	NIBP Pediatric disposable cuff	❑ 971029	Paddle holder/charger
❑	001957	IBP Adapter cable	❑ 002115	Zoll pad adapter cable
❑	001941	Quick combo pad adapter		

Technical Specifications

Defibrillator

Waveform: Precise Trapezoidal (per AAMI Standard for Truncated Exponential Waveforms.)

Waveform Details: Models PIC and MRL Lite

Peak current (Ip) and duration (t) at 360 Joules delivered energy. (The values shown are within 10%)

Load (Ohms)	Ip (Amps)	t (ms)
25	53.1	10.0
50	27.1	18.8
100	13.7	36.4

Waveform: MRL Bipahsic (optional)

Waveform Detals: Models PIC 2 and MRL Lite 2

Load(Ohms)	Ip(Amps)	tphase1(ms)	tphase2(ms)
25	51.5	5.4	3.1
50	26.3	11.2	6.6
100	13.3	16.6	8.4

Waveform: High Voltage Truncated Exponential Biphasic (optional)

Output Energy Accuracy:

+/- 10% at 50 ohms
+/- 15% at 25 to 100 ohms

Waveform Details: 2 - 360 joules; Models PIC 2H and MRL Lite 2H

Load(Ohms)	Ip(Amps)	tphase1(ms)	tphase2(ms)
25	69.3	5.1-6.0	3.2-4.6
50	37.8	6.8-7.9	4.0-5.6
100	19.8	8.6-10.6	5.8-7.1

Energy Select:

External: 2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, 360 J.
Internal: 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50 J.

Charge Time:

< 7 seconds @ 360 J (with a SmartPak Plus battery after 15 discharges).
< 9 seconds @ 360 J (with a SuperPac battery after 15 discharges).
< 15 seconds @ 360 J (no battery, 90% AC mains voltage)

Charge Indicator: Audible and graphic.

Output:

Adult paddles, internal paddles, peds adapter and multipurpose hands-free adapter available.

Synchronizer: Delivers energy within 60 msec.

Disarm: Front panel switch.

Monitor / Display:

Input:

3-lead or 5-lead patient cable, paddles, or multipurpose hands-free adapter.

Size: 6.5 inches (16.5 cm) diagonal, non-fade.

Type: Electroluminescent (EL) display.

Display Resolution: 640 x 480 pixels.

Sweep Speed: 25 mm / sec.

Lead Selections: Paddles (Pads), I, II, III, AVR, AVL, AVF, V.

Frequency Response: (User-selectable).

2 to 20 Hz	Limited mode
1 to 40 Hz	Monitor mode
0.05 to 150 Hz	Diagnostic mode

(automatically sets chart recorder response)

Common Mode Rejection:

Complies with AAMI EC13-1992 section 3.2.9.10.

Tall T-Wave Rejection:

Meets AAMI EC13-1992, section 3.1.2.1c for 1.2 mV T-wave (1.0 mV with diagnostic response) and 1mV QRS.

Diagnostic Signals Applied to Patient Connections:

Leads off / active noise suppression sensing circuit is < 0.1mA DC. The impedance / respiration detector signal frequency is 45 ± 4kHz at 78mA RMS (117mV RMS into an impedance of 1.5k?) pseudo-sinewave.

Heart Rate Meter: 20 to 300 BPM.

Heart Rate Alarms: User-selectable.

Size: 0.125, 0.25, 0.5, 1, 2, 4 cm/mv and auto-ranging.

Aspect Ratio: 0.05, 0.1, 0.4, 0.8, 1.6, respectively.

ECG Output: 1 V/mV.

Heart Rate Meter Response Time:

Responds to a 40 BPM step increase in heart rate in 2 to 4.5 seconds per AAMI EC-13-1992, section 3.1.2.1.f. Responds to a 40 BPM step decrease in 1.4 to 3.9 seconds per AAMI EC-13-1992, section 3.1.2.1.f. Response times include a 2.5-second display update interval.

Heart Rate Response to Irregular Rhythm: (AAMI EC13-1992, section 4.1.2.1.e.)

Ventricular Bigeminy: 80 BPM (expected)
Slow AlternatingVentricular Bigeminy: 60 BPM (expected)
Rapid Alternating Ventricular Bigeminy: 120 BPM (expected)
Bidirectional Systole: 45 BPM (expected)

Tachycardia Response Time:

Response time to tachycardia alarm is on average 3.43 seconds (with a range of 1.15 to 10.69 seconds) per AAMI EC-13-1992, section 3.1.2.1.g. Response times include a 2. 5second display update interval.

Alarms

Heart Rate, BP, SpO2, Resp & Temp Alarm:

Audible: 5 pulse, 800 tone, with a PW of 150 msec, a PRI of 225 msec, and a repetition interval of 10 seconds.

Visual: Heart Rate Alarm causes the displayed heart rate to flash at 2 Hz. This display is located at the top of the display and is 0.4" high and 0.28 to 0.840" wide depending on number of digits in the heart rate. Color is amber, black, white, or whatever the color the display text is.

Lead Fault Alarm:

Audible: 3 pulse, 500 Hz, triplet tone with a PW of 200 msec, a PRI of 310 msec. When the HR alarm is set or the pacer is on, the lead fault tone repeats at a repetition interval of 20 seconds.

Visual: Lead Fault condition causes a “LEAD FAULT” message to be displayed on the trace along with a dashed line the width of the trace. The text is 0.18" high and is the color of the display text. The dashed line is 5" long, the width of the display. The signal is not modulated.

Physiological Alarms (BP, SpO2, Resp & Temp):

Audible: See Heart Rate Alarm

Visual: Physiological alarms cause the displayed parameter to flash at 2 Hz. Color is amber, white or the same as the display colored text.

Mute Duration: 90 seconds.

Recorder

Type: High-resolution thermal array.

Annotation: Time, date, ECG lead, ECG gain, heart rate, defibrillation and

pacing parameters and treatment summary ACLS events.

Paper Width: 50 mm.

Paper Speed: 25 mm/sec.

Delay: 6 seconds.

Frequency Response:

Automatically set to monitor's frequency response.

Treatment Summary:

7 switches to record key ACLS events (IV, INTUB, EPI, LIDO, ATROP, etc.). Automatically logs into memory the type of event, time and ECG sample.

Tx Summary Log: 28 ECG events or 300 non-ECG events.

Record Modes: Manual and automatic (User-configurable).

Battery

Standard Type: NiCad 12 volt - MRL SmartPak Plus ™.

Standard Capacity:

Up to 2 hours ECG monitoring or 60 full-energy discharges or 1.5 hours combined ECG, SpO2 and BP monitoring while pacing. Actual operating times will depend on the number of features activated and the duration of their use. Proper battery care is required to maintain maximum available capacity.

Self-Test:

Bi-color LED indicates battery charge state. Green = usable charge, Red = requires charging.

Low Battery Indicator:

Flashing low battery icon on display and flashing LED on

battery.

Recharge Rate: 80% in 3.5 hours. 100% in 4.5 hours.

High Capacity Type: NiMH 12 volt - MRL SuperPac^{TM}.

High Capacity:

Up to 4 hours ECG monitoring or 110 full-energy discharges or 3 hours combined ECG, SpO_2 and BP monitoring while pacing. Actual operating times will depend on the number of features activated and the duration of their use. Proper battery care is required to maintain maximum available capacity.

Recharge Rate: 80% in 7.5 hours. 100% in 9.5 hours.

Multiple Paired Contacts:

Insures quick, error-free insertion and backup reliability.

General

Weight: 10 pounds (4.95 kg) (basic configuration).

Size: 13 x 12.5 x 5.3 inches (33 x 31.8 x 13.5 cm).

Operating:

Temperature*: 0 to 45° C
Humidity* (NC): 15 to 95% RH (30 to 90% with CO_2 probe)
Vibration*: MIL-STD 810E
Shock / Drop*: MIL-STD 810E
Altitude: Up to 4572 M (15,000 feet)

Transport and Storage:

Temperature: -30 to 70°C (-20 to 70°C with CO_2 probe)
Humidity: 15 to 95% RH (non-condensing)
Atmospheric pressure: 860 to 1060 hPa
Shock/vibration: ISTA 1A

Enclosure Protection*:

Solid Foreign Object: IEC 529, IP2X
Water: IEC 529, IPX4.

* All tests performed per AAMI DF-2 Defibrillation Standard.

Operating Power:

MRL SmartPak or auxiliary power from MRL Quick Charger.

Pacer

Type: External transmittances pacing.

Pacer Rate: 30 to 180 BPM ± 5%.

Output Current:

30 to 180 mA ± 10% or 5 mA (whichever is greater).

Modes: Demand and asynchronous.

Status Indicators:

ECG lead fault, pace lead fault, pace marker on monitor and chart, start/stop LED

Pulse Type: Rectangular, constant current.

Pulse Width: 20 ms.

Refractory Period: 250 ms.

Output Protection: 360 Joules.

SAED Rhythm Recognition Performance

The PIC SAED algorithm exceeds the requirements of ANSI/AAMI DF39-1993 section 3.3.18 and the sensitivity and specificity levels recommended by the AHA (*Automatic External defibrillators for Public Access Use: Recommendations for Specifying and Reporting Arrhythmia Analysis Algorithm Performance*). The test database includes shockable rhythms consisting of ventricular fibrillation rhythms (>150uV) and wide-complex ventricular tachycardia at a rate greater than 160 BPM. Non-shockable rhythms include various sinus rhythms including supraventricular tachycardia, atrial fibrillation, atrial flutter, sinus rhythm with PVC's, asystole, pacemaker rhythms, and ventricular tachycardia with a rate less than 160 BPM and/or narrow complexes.

Rhythm Recognition Test Results:

Specificity (non-shockable)
Exceeds AAMI Requirement: >95% and AHA recommendation: >99%

Sensitivity (VFIB)
Exceeds AAMI Requirement and AHA recommendation: >90%

Sensitivity (VTACH)
Exceeds AAMI Requirement and AHA recommendation: >75%

CO_2 (optional)

Mainstream CO_2: CO_2 and $ETCO_2$ display

Range: 0 to 76 mmHg

Accuracy CO2: + 4 mmHg (< 40 mmHg), + 10% (>40mmHg)

Resolution: 1 mmHg

Respiration Range: 2 - 60 bpm

Apnea Indication: 20 seconds (CO2 level < 5 mmHg)

Pulse Oximeter (optional)

Measurement Range: 31 to 99%.

Heart Rate Range:

30 to 250 BPM ± 5% or 5 BPM whichever is less.

Accuracy:

81 to 99% = ± 2%, 70 to 80% = 3%, 0 to 69% unspecified.

Update Period: Every pulse after 4 valid pulses.

Messages:

Check Probe
Searching
Signal OK
No Signal
Low Perfusion
Alarms Enabled/Disabled (icon)
Testing.

Alarm Limits: 60 lower limit, 70 upper limit to 99%.

Probe: Finger or multi-site probe.

Blood Pressure (optional)

Technique:

Non-invasive oscillometric method, referenced to auscultatory standard, using the 5th Korotkoff sound as the diastolic reference.

Operating Modes: Automatic and manual

Initial Cuff Inflation:

Adult and child: 154 mmHg
Infant: 125 mmHg.

Automatic Cycle Times: 1, 2, 3, 5, 10, 30 minute intervals

Blood Pressure Range:

Systolic: 30 to 245 mmHg, diastolic: 10 to 210 mmHg

Heart Rate Range: 30 to 250 BPM ± 10% or 5 BPM

Blood Pressure Accuracy:

+5 mmHg mean error, +8 mmHg standard deviation

Blood Pressure Validation:

Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultation method within the limits prescribed by the American National Standard Institute.

Alarms:

Artifact
Check Cuff
Tighten Cuff
Cuff Leak
Motion

Alarm Limits:

Systolic: 30 to 245 mmHg
Diastolic: 25 to 210 mmHg

IBP

Number of Channels: 2

Display:

Numerical and one or two graphical waveforms

Numerical: Systolic, Diastolic, Mean pressure

Waveform Display Ranges: 40, 80, 160, 300mmHg

Waveform Labels: ART, CVP, PA, ICP, Misc P

Pressure range: -30 to 300mmHg

Accuracy:

+/- 2 mmHg or 2% of reading, whichever is greater, plus transducer error.

Transducer:

Sensitivity: 5uV/V/mmHg

Offset: +/- 125 mmHg including transducer offset

Excitation Impedance Range: 150 to 10,000 ohms

Excitation Voltage: 4.75 +/- 0.25 VDC

Connector: 6-pin circular MS3100 series

Connect to:	A	B	C	D	E
Signal Type	Sig (-)	Exc (+)	Sig (+)	Exc (-)	shield

Temperature with NIBP (optional)

Measurement Range: 0° to 50° C.

Accuracy: ± 0.2° C.

Resolution: 0.1° C.

Scale: Fahrenheit or Celsius.

Probe: YSI Series 400.

Alarm Limits:

High (99-109°F) (37 - 42°C) and low (85-98°F) (29-36°C) alarm limits.

MRL Quick Charger

Mains (Line) Voltages:

100 to 240 VAC (four user-selectable ranges: 100, 120, 220, 240 VAC)

Mains (Line) Frequency: 50 to 60 Hz

AC Power Consumption:

50 W-while charging batteries only
70 W-while powering monitor
300 W-while charging defibrillator

Charger Bays: Three (charges three batteries concurrently).

Indicators:

Battery Charging/Ready
Reconditioning
Defibrillation Test Indicator
Power On

Reconditioner: Simple, one button operation.

Reconditioning Load:

220 mA ± 10% constant. Optimized for signal reconditioning.

Recondition Cycle Time:

Dependent on battery capacity and state of charge (typically < 12 hours).

External Power Output Voltage: 13 Volts ± 0.65 V.

Fuse Ratings: Dual Line Fuses

120 VAC-2 Amp SB (MRL # 500218)
220 VAC-1 Amp SB (MRL # 500241)

General Charger:

Operating Temperature: 0 to 45°C
Humidity: 15 to 95%
Size: 11.5 x 7.25 x 4.4 inches (29.2 x 18.4 x 11.2 cm)

Defibrillator Tester: Built-in 50 Ohm load.

Paddle Holder/Charger:

Mains (Line) Voltage: 100 to 240VAC + 10% (autoranging)

Mains (Line) Frequency: 50 to 60 Hz + 5%

AC Power Consumption: 18 W (Typical), Maximum 190 W (while charging defib)

CHAPTER 3: MENUS

This chapter covers in detail all the User and Suprvisory Configuration Menu Options available in the PIC System.

Chapter Overview:

- *User Menu Overview 3.2*
- *Supervisor Menu Overview 3.3*
- *Quick Access Buttons and Icons 3.5*
- *Quick Access Buttons and Pop-up Menus. 3.6*
- *User Menus 3.7*
- *User Menus – Display 3.8*
- *User Menus – SPO_2 . . . . . 3.11*
- *User Menus – Non-Invasive Blood Pressure 3.12*
- *User Menus – Respiration (ECG) 3.13*
- *User Menus – Respiration (CO_2) 3.15*
- *User Menus – Respiration (Trend). 3.17*
- *User Menus – Recorder. 3.18*
- *User Menus – Setup 3.20*
- *Supervisor Menus 3.22*
- *Supervisor Menus – Defibrillator 3.23*
- *Supervisor Menus – Pacer. 3.25*
- *Supervisor Menus – SAED 3.26*
- *Supervisor Menus – 12-lead 3.28*
- *Supervisor Menus – Setup. 3.30*
- *Supervisor Menus – Calibration. 3.35*

User Menu Overview

Configuration Menu	Submenu	Choices	Choice Range	Factory Default
Display	Traces	Waveform2 Waveform3	Off, Resp, Pleth, IBP1, IBP2 Off, Resp, Pleth, IBP2, IBP1	Off Off
	Freq	Limited (2-20 Hz) Monitor (1-40 Hz) Diagnostic (0.05-150 Hz)		Monitor
	Filter	Off, On		On
	Pt Cable	3-lead 5-Lead		3-Lead
Alarms	IBP			
	HR Alarms	Off, On, Auto UL: Disabled, On LL: Disabled, On	 60 - 300 BPM; by 5's 20 - 120 BPM; by 5's Automatically determined	Off 120 50
	SPO_2 Alarms†	Off, On UL: Disabled, On LL: Disabled, On	70% - 99%; by 1's 60% - 99%; by 1's	Off 99 85
	NIBP Alarms†	NIBP IBP1 IBP2	Off, On, Set Sys, Set Dia Sys UL: Disabled, On, 30 - 250 by 5's Sys LL: Disabled, On, 30 - 250 by 5's Dia UL: Disabled, On, 25 - 250 by 5's Dia LL: Disabled, On, 25 - 250 by 5's	Off 160 80 130 50
	Resp Alarm	Off, On UL: Disabled, On LL: Disabled, On	 20 - 150; by 5's 3 - 100; by 5's > 15 and by 1's < 15	Off 30 5
	Temp Alarm†	Off, On UL: Disabled, On LL: Disabled, On	 99 - 109; by 1's 85 - 98; by 1's	Off 100°F 95°F
SPO_2†	Size	x.25, x.5, x1, x2		0.25
NIBP†	NIBP	Manual Auto Stat	 1, 2, 3, 5, 10, 15, or 30	Manual 5
Respiration	ECG Resp Setup	Size Speed Response	x1, x2, x4 5, 10, 20, 30, 60 sec Slow, Normal, Fast	1 30 Normal
	CO_2 Setup	Size Speed Response	0-20, 0-40, 0-80 mmHg 5, 10, 20 sec slow, normal, fast	
	Trend	Trend, Reset	10 min, 30 min, 2 hr, 6 hr, 12 hr	
Recorder	Print Grid	On, Off		On
	Log	Print Log, Print Trend, Stop Print, Clear Log		
	Review†	Continue, Cancel		
	Voice Memo† Trends	Play, Skip Fwd, Skip Bwd, Stop On, Off at B/P, 30 sec, 1, 2,3, 5 min		 On at B/P
Set Up	Suprvsr	Enter code, reset to 0	0 -9	1, 2, 3, 4
	Date	Month Day Year	January thru December 0 - 31 99, 00, 01, 02, 03....	
	Time	Hour Minute	1 - 23 0 - 60	
	Active Shift	Shift 1, Shift 2, Shift 3, Defaults		

† If option has been purchased.

Supervisor Menu Overview

Menu	Submenu	Choices	Choice Range	Factory Default
Defibrillator	Ext Energy		2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, 360	200 Joules
	Int Energy		2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 50	20 Joules
	Mode (sync after cv)	On, Off		Off
	Charge Alarm	Alarm Volume, Max. Volume	OK	
Pacer	Rate		30 - 180; by 5's < 100 and 10's > 100	60
	Mode	Async or Demand		Demand
SAED†	Set ALS Code	0 0 0 0 Cancel	0-9 0-9 0-9 0-9 Required, not required	1 2 3 4 Required
	E Prot (SAED Protocol)	200-200-360 or 200-300-360		200-300-360 Joules
	SAED Audio†	Memo, Start/Stop, Continuous		Continuous†/ Memo
	Startup	Manual, Basic+, Basic		Basic
12 Lead†	Phone	Name, Prefix, Phone Number, Postfix, Receiver Type	16 phone numbers	
	Copies	1, 2, 3, 4, 5		1
	Fax	Grid Audio Output Baud Rate Fast Fax	Full Grid, Partial Grid On, off 2400, 4800, 7200, 9600 Enabled, Disabled	Full Grid On Disabled
	Freq	Filt Diag, Diagnostic		
	Analysis	Manual, Automatic		
Set Up	Shifts	Save as 1, 2, 3, Save to card, Load from card		
	Treatment	Button 1, 2, 3, 4, 5	Intubate, Lido, Bret, CPR, Arrival, Event, Atrop, IV/Surg, Sedate, Narcotic, Dry-Agt Anesth, Custom1-2-3-4-5, Sample, IV, EPI	Intubate IV, EPI, Lido, Bret
	Upgrade	SAED, CO2, IBP, ADV, Record, Review, Biphasic, Pacer, Fax		
	Unit ID	Department ID, Unit ID		1,1
	Code	0 0 0 0 Cancel	0 - 9 0 - 9 0 - 9 0 - 9	1 2 3 4
	Printer	Alarms Defib/Pacer Trending Treatments Miscellaneous	On, Off On, Off On, Off On, Off On, Off	On On On On On

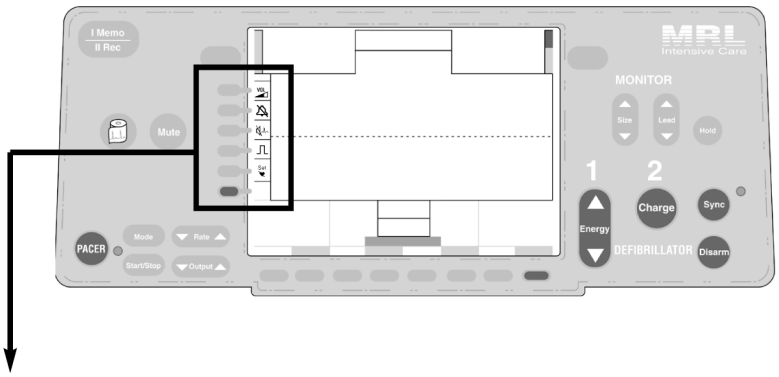
Menu	Submenu	Choices	Choice Range	Factory Default
	More	Date	mm/dd/yy, dd/mm/yy, yy/mm/dd	mm/dd/yy
		Temp	Fahrenheit (°F), Celsius (°C)	°F
		Line Freq	60 Hz, 50 Hz	60 Hz
		Audio†	Voice Prompts (Enabled, Disabled)	Disabled
			Voice Mode (Memo, Start/Stop, Continuous)	Memo
			Voice Log (Enabled, Disabled)	Enabled
		Language	English, Spanish, French, German, Portuguese, Italian	
		Lead	I, II, III	II
Calibration	Software Rev	Motherboard, Preamp, Defib, Oximeter, BP		
	Modem	Run Self Test		
	Card	Card Info		
		Card Erase		
		Program PIC		
	Cal	NIBP†	Pump Up, Pump Down	
		SPO_2†	-2, -1, 0, 1, 2	
		Mod Out	0 m V, 1 mV, + MAX, - MAX, Off	
		CO_2	Simulate, Reset	

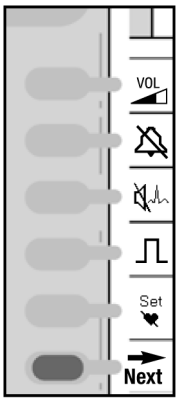
† If option has been purchased.

Quick Access Buttons and Icons

Quick Access buttons and icons are located along the left side of the PIC display window. Press a button next to an icon to select a PIC System option or function.

Basic Quick Access Buttons and Icons





VOL **VOLUME**: Adjusts the overall volume on the PIC System.

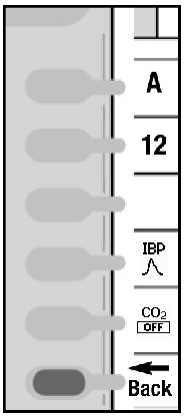
GLOBAL ALARMS: Enables and disables global alarms.

QRS BEEPER: Enables and disables the QRS Beeper.

CALIBRATION: Calibrates the display.

Set **SET HEART RATE**: Sets the value to be use in automatic HR alarm settings.

NEXT: Open another Quick Access window if advanced options (12-lead, CO2, IBP, etc.) are available.



A **ADVISORY** (optional): Analyzes current ECG as shockable or non-shockable.

12 **12-LEAD** (optional): Allows the operator to acquire a 12-lead analysis.

Log **LOG**: Displays the items stored in the log file.

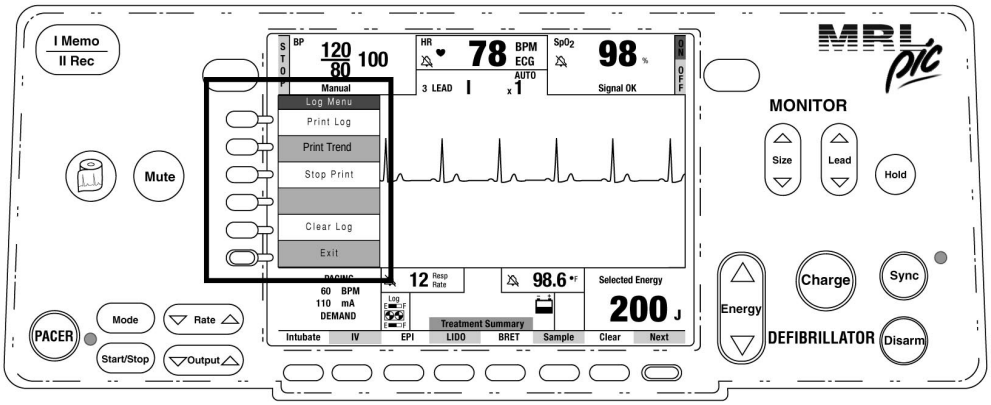
IBP (optional): Allows the operator to measure pressure invasively.

CO_2 (optional): Allows the operator to measure end-tidal carbon dioxide levels.

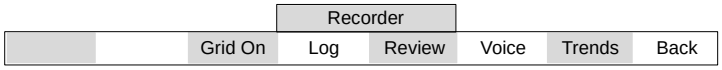
BACK: Return to the previous quick access window.

Quick Access Buttons and Pop-Up Menus

The Quick Access buttons are also used to select pop-up menu options, including the User and Supervisor menu options.

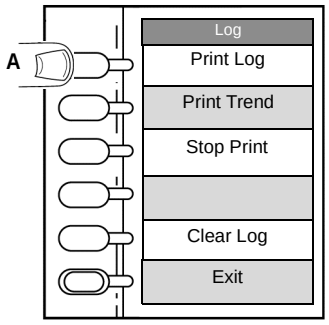


Sample Menu



When you select an item on a menu located along the bottom of the PIC window, a pop-up menu will display next to the Quick Access buttons (along the left side of the display).

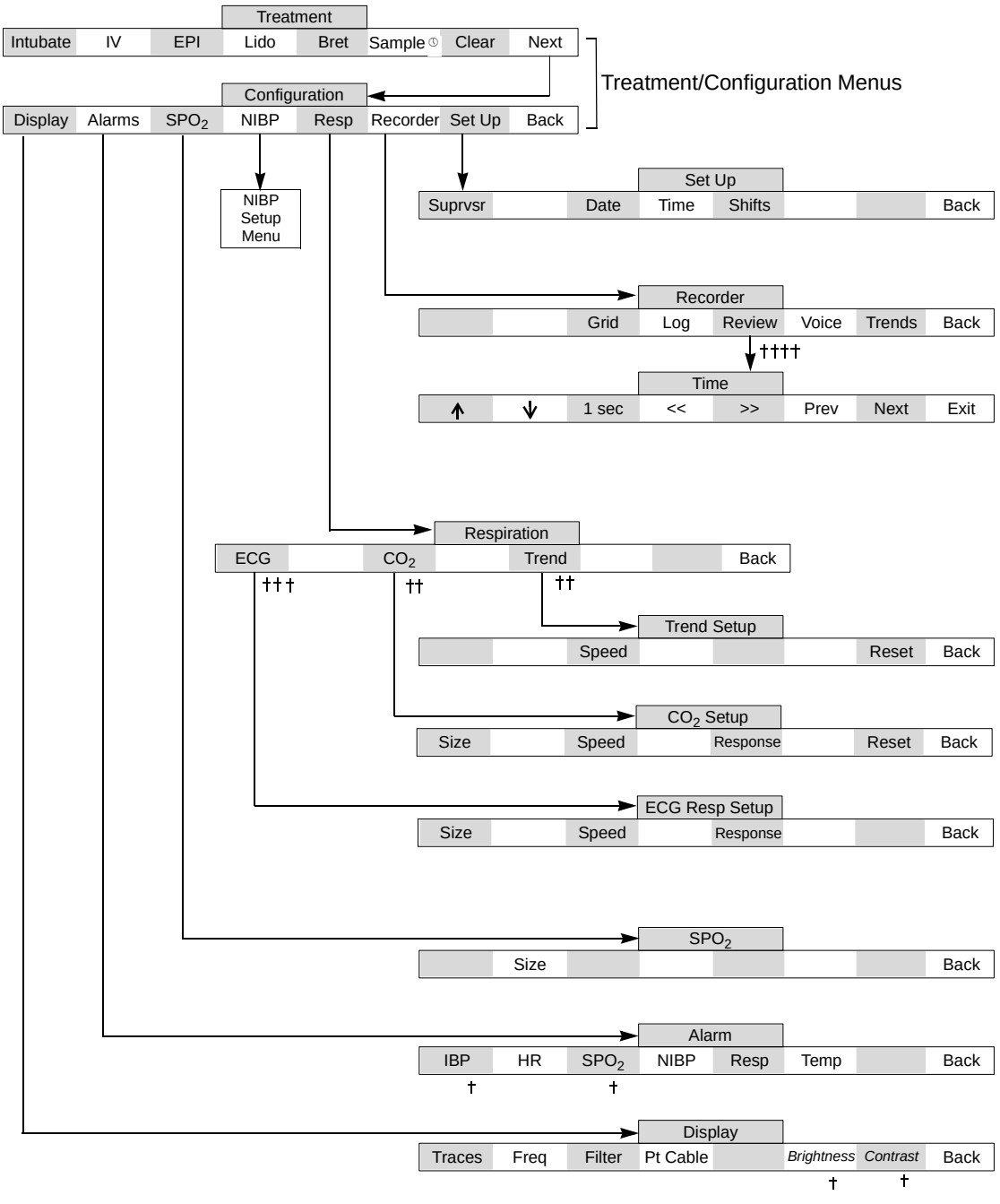
Sample Pop-Up Menu



To select a pop-up menu option (or enter information), press the Quick Access (A) button located next to your selection.

User Menus

User menus can be accessed by all operators and do not require a supervisor pass code. Operators can configure a variety of PIC system options including some of the display features. The User menus are shown in the following diagram. This section also provides an explanation of how to access and set User menu options.



† Available only if purchased

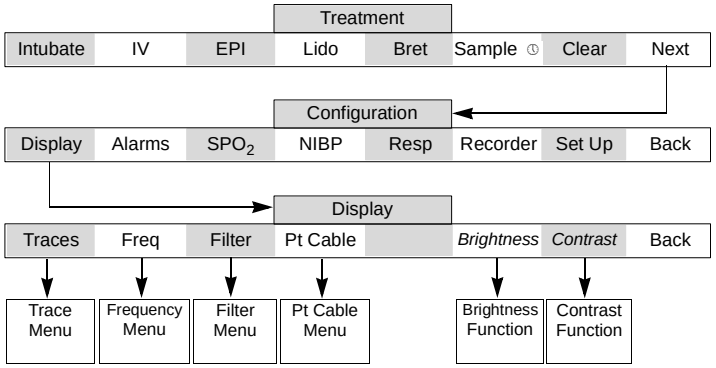
††† Available only in 5-Lead PICs

†† Available only in 12-Lead PICs

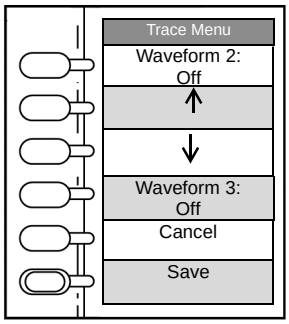
†††† Visible only if memory card is in place

User Menus – Display

The Display menu options allow users to configure the PIC Display area to show multiple traces; choose frequencies, patient cable, and filter options; and adjust the brightness and contrast (if the display type supports variable brightness and contrast). The Display options are accessed from the Treatment/Configuration menus.

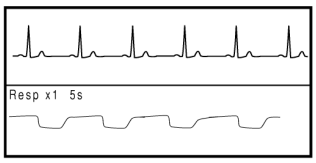


Trace Menu

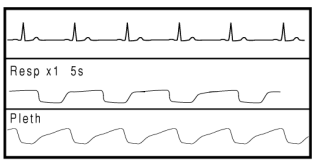


In the Trace menu, users can choose from several ECG trace display parameters including Resp, Pleth, or Off for waveforms 2 or 3. If the PIC includes the 12-lead option, users can select lead I, II, III, aVR, aVL, aVF, V1, 2, 3, 4, 5, 6, ETCO2, Pleth, or Off for waveform 2 or 3. Press the **UP** and **DOWN** arrow buttons to select an option. Press **SAVE** to save the current selections.

ECG Waveform

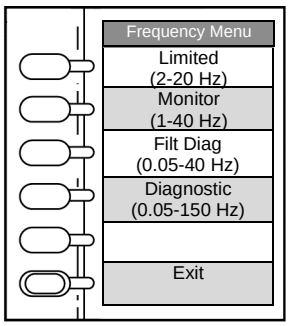


ECG and Waveform 2: Resp



EGC, Resp, and Pleth Waveform

Frequency Menu



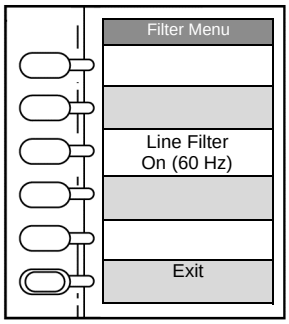
Use the Frequency menu selections to set the display and chart recorder responses. Four frequency options are available:

- **Limited** response is best used for paddle monitoring applications.
- **Monitor** response is best used for general ECG monitoring applications.
- **Filt Diag** is best used in the field when noise and or artifacts are a problem. This option is only available if the 12-Lead Preamp Board (ECG option) is installed. This selection does not affect the filtering used to acquire a 12-lead sample.
- **Diagnostic** response should be used when attempting to interpret subtle ECG changes (ST segments).

Press the button next to a frequency to select it. A bold outlined box indicates the selected frequency.

Press **EXIT** to return to the Display Configuration menu.

Filter Menu

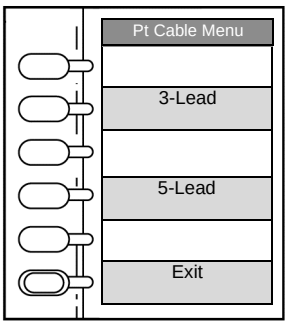


In the Filter menu, press the Line Filter button to turn line filters On or Off. The filters remove AC (mains) line interferences emitted from power lines and other electrical apparatus. Turn the filter off for optimal diagnostic response.

Press **EXIT** to return to the Display Configuration menu.

NOTE: To select a different line frequency, refer to Supervisor Line Frequency menu.

Patient (Pt) Cable Menu



In the Patient Cable menu, users can select a 3-lead or 5-lead patient cable. Press the corresponding button to choose a lead configuration. A bold outlined box indicates the selected configuration.

If the patient cable inserted into the PIC System does not match the selected patient cable configuration, a lead fault alarm may sound.

Press **EXIT** to return to the Display Configuration menu.

NOTE: This menu is not available on PIC Systems with 12-lead preamplifiers because the 12-lead preamp auto-detects the patient cable type.

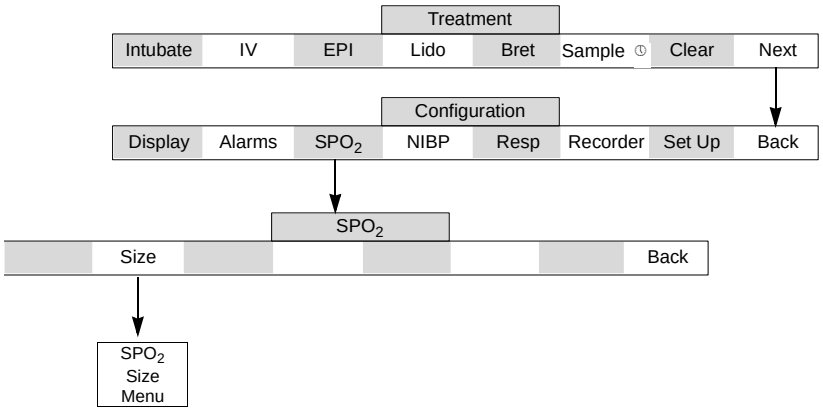
Brightness and Contrast Options

The level of brightness and contrast in the PIC display is adjustable. Press the **BRIGHT** button to brighten the display. Press the **CONTRAST** button to add contrast to the display. Each press of a button will increase the brightness or contrast setting until the highest setting is reached. The next press of the button will return the setting to the lowest level.

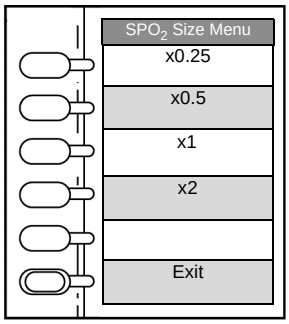
NOTE: The Brightness and Contrast buttons are only visible if your display type supports variable brightness and contrast.

User Menus – SPO_2

From the SPO_2 menu, users can configure the pulse oximeter size. The Pleth (Plethysmograph waveform) display is automatically gain controlled and is not directly proportional to the pulse volume. The SPO_2 options are accessed from the Treatment/Configuration menus.



SPO_2 Size Menu



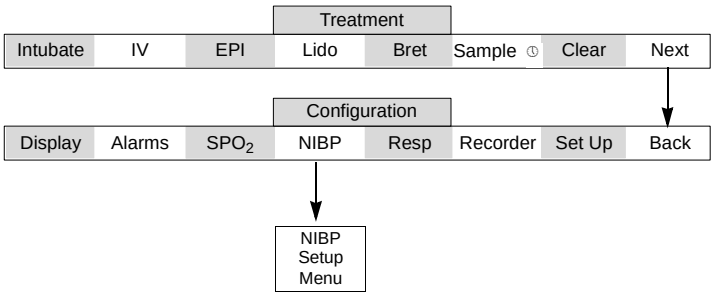
In the SPO_2 Size menu, users can choose from four Pleth sizes. A bold outlined box indicates the selected size. To choose a different size configuration, press the corresponding button.

Press **EXIT** to return to the SPO_2 Configuration menu.

NOTE: The Plethysmograph waveform is automatically gain controlled to optimize the waveform display. The waveform will not correlate with the patient's pulse strength.

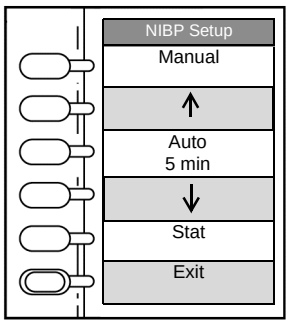
User Menus – Non-Invasive Blood Pressure

The three non-invasive blood pressure (NIBP) reading modes are available. Users select the NIBP mode from the NIBP Setup menu, which is accessed through the Treatment/Configuration menus.



NIBP Setup Menu

In the NIBP Setup menu, users can select the Manual, Auto, or Stat mode.



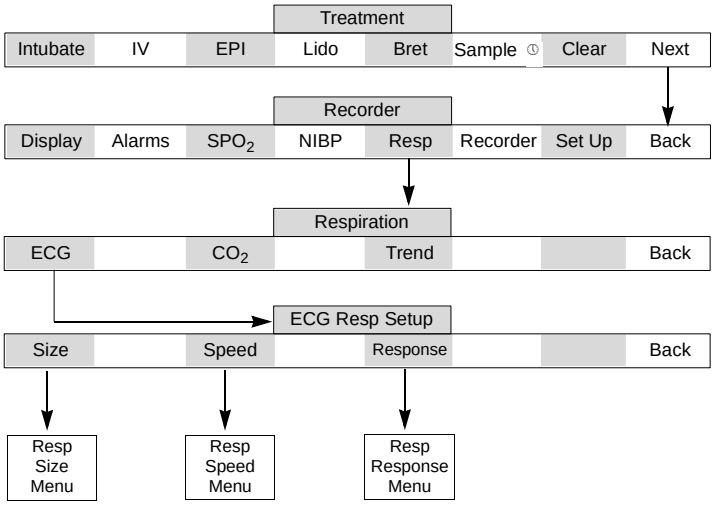
- **Manual**: a blood pressure reading will be taken each time the **NIBP** button is pressed.
- **Automatic** (**Auto**): a blood pressure reading will be taken at the indicated interval. To increase or decrease the interval, press the **UP** or **DOWN** arrow buttons.
- **Stat**: blood pressure readings will be taken one after another for five minutes starting from the time the **NIBP** button is pressed.

A bold outlined box indicates the selected NIBP Setup configuration. Press **EXIT** to return to the Configuration menu.

User Menus – Respiration (ECG)

Respiration data is sourced from ECG leads. Users can configure the size, speed, and response settings of the ECG respiration display using the Respiration menus. Access the Respiration menus from the Treatment/Configuration menus.

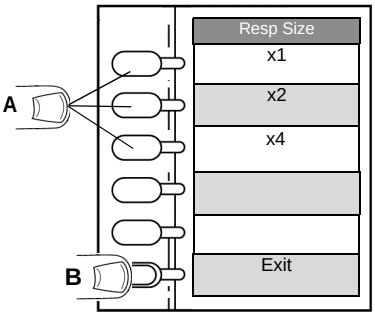
NOTE: Respiration is not available when the 12-Lead option is activated.



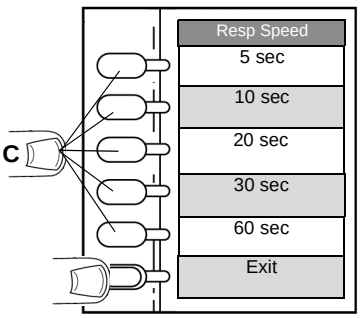
Resp Size Menu

Use the Resp Size menu to adjust the size of the displayed respiration trace. Press **x1**, **x2**, or **x4** (A) to select the waveform size. A bold outlined box indicates the selected size.

Press **EXIT** (B) to return to the Resp Configuration menu.



Resp Speed Menu

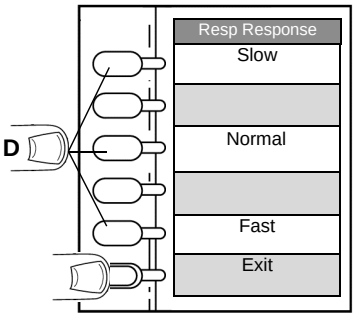


Use the Resp Speed menu to adjust the Respiration trace speed on the display and allow manual calculation of the respiratory rate.The respiration waveform speed (time it takes the trace to travel from the left side to the right side of the display) options are 5, 10, 20, 30, or 60 seconds (C).

A bold outlined box indicates the selected speed. Press **EXIT** to return to the Resp Configuration menu.

Response Menu

Use the Respiration Response menu to select the averaging interval that will be used during a respiration measurement.



Slow: averages the respiratory rate on a moving 60-second average.

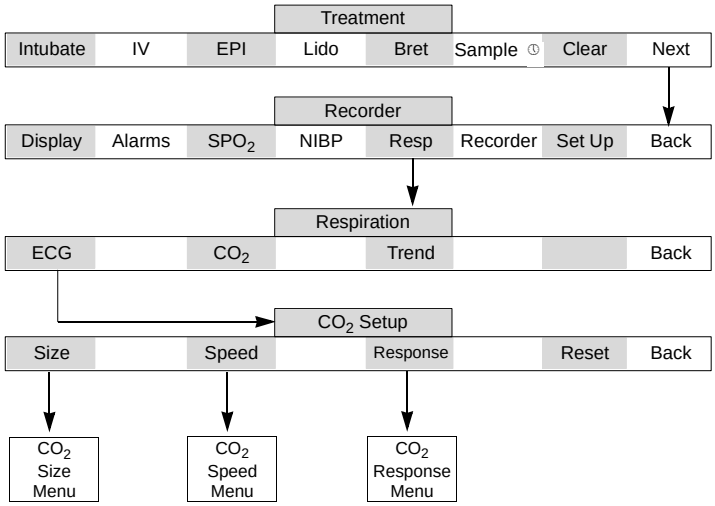
Normal: averages the respiratory rate on a moving 30-second average.

Fast: averages the respiratory rate on a breath-by-breath basis.

Press a button (D) to select a response rate. A bold outlined box indicates the selected response. Press **EXIT** (B) to return to the Resp Configuration menu.

User Menus – Respiration (CO_2)

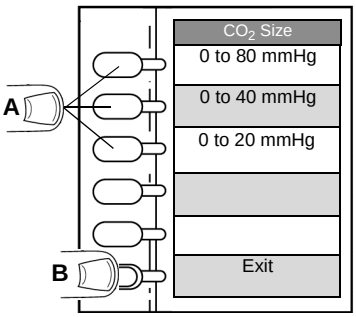
Respiration data is sourced from ECG leads or the CO_2 sensor, and defaults to the CO_2 sensor, if active, for improved accuracy and response. Use the CO_2 menu to configure the CO_2 size, speed, and response display settings. Access this menu from the Treatment/ Configuration menus.



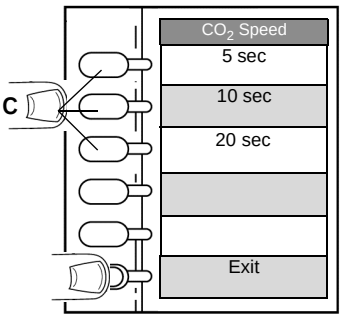
CO_2 Size Menu

Use the CO_2 Size menu to select the displayed CO_2 trace size. Press a button (A) to select a size scale, 0 to 80 mmHg, 0 to 40 mmHg, or 0 to 20 mmHg. A bold outlined box indicates the selected option.

Press **EXIT** (B) to return to the CO_2 Configuration menu.



CO_2 Speed Menu

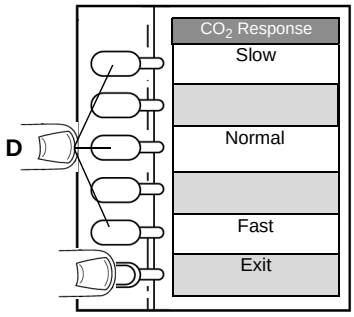


Use the CO_2 Speed menu to adjust the displayed CO_2 trace speed (5, 10, or 20 seconds) and allow manual calculation of the respiratory rate. Press a button (C) to select the trace redraw speed (time trace travels from the left side of the display to the right). A bold outlined box indicates the selected speed.

Press **EXIT** to return to the CO_2 Configuration menu.

CO_2 Response Menu

CO_2 Response adjusts the averaging interval during a CO_2 measurement. Press a button (D) to select a rate.



Slow averages the CO_2 level on a moving 60-second average.

Normal averages the CO_2 level on a moving 30-second average

Fast averages the CO_2 level on a breath-by-breath basis.

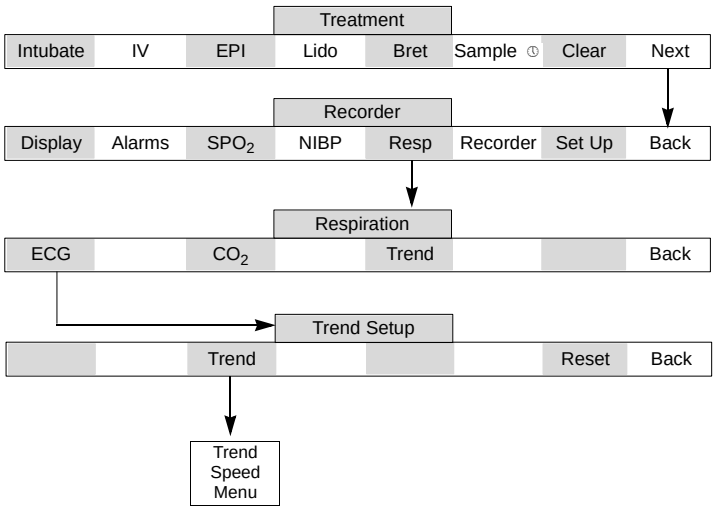
A bold outlined box indicates the selection. Press **EXIT** to return to the CO_2 Configuration menu.

Reset Option

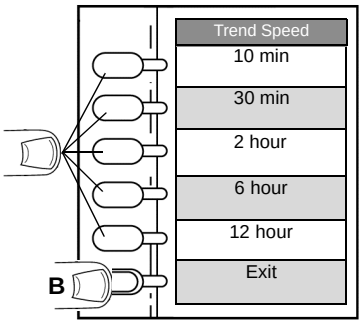
The Reset option sends a Reset signal to the CO_2 sensor. The signal is used for diagnostic purposes only.

User Menus – Respiration (Trend)

Use the Trend Respiration menu to configure the trend speed setting. This menu is accessible through the Treatment/Configuration menus.



Trend Speed Menu

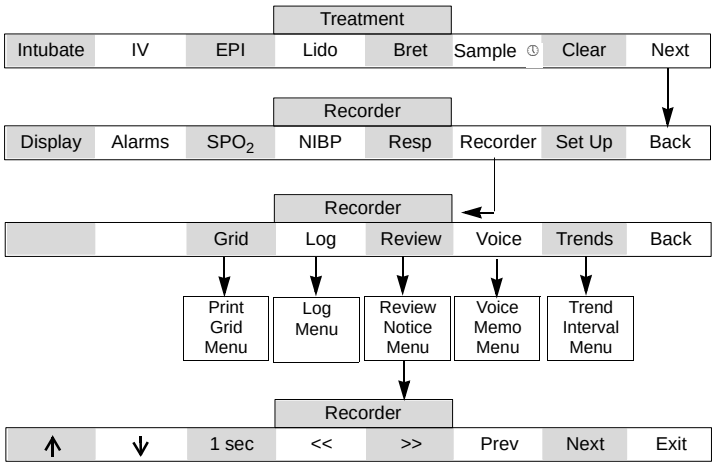


Use the Trend Speed to select the amount of time the system will monitor the ECG or CO_2 function. The options are 10 min, 30 min, 2 hours, 6 hours, or 12 hours (A). The selected option is used to determine the maximum, minimum, and mean rate for each of 120 intervals. Depending on the option selected, the display trace segments (max, min, and mean) will be 5 sec, 15 sec, 1 min, 3 min, and 6 min respectively.

A bold outlined box indicates the selected speed. Press **EXIT** (B) to return to the Trend Configuration menu.

User Menus – Recorder

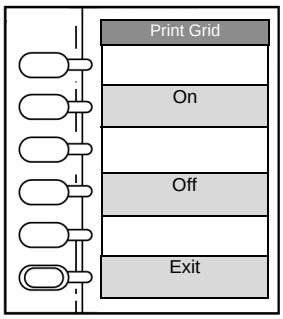
The Recorder menu allows users to configure the system recording options including print grid, log, review option, voice memo, and trends. Access to this menu is through the Treatment/Configuration menus.



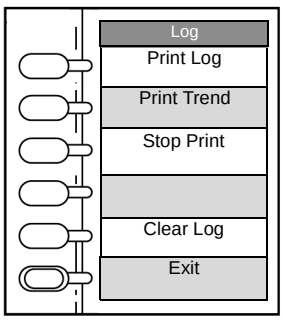
Print Grid Menu

In the Print Grid menu, users can choose to print or not print a grid on the chart paper. Press the **ON** button to print a grid on plain white paper. Select **OFF** and a grid will not be printed. A bold outlined box indicates the selected option.

Press **EXIT** to return to the Recorder Configuration menu.



Log Menu



The Log menu allows the user to print, review, or clear the internal log.

See chapter 12 in the *PIC System User Instruction Manual* for specific instructions on how to use this function.

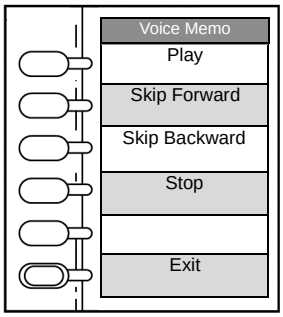
Press **EXIT** to return to the Recorder Configuration menu.

Voice Memo™ Menu

The Voice Memo™ menu allows the user to select play, skip forward, skip backward, and stop options for voice memo recordings stored in the PIC.

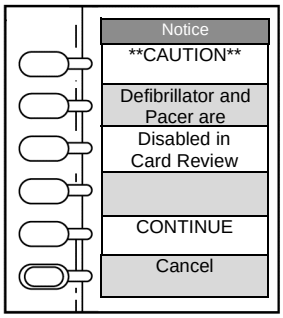
See chapter 12 in the *PIC System User Instruction Manual* for information on how to use this function.

Press **EXIT** to return to the Recorder Configuration menu.



NOTE: This menu is not visible if the speech card option is not installed.

Review Menu



If the Memory Card Review option was purchased and a valid datacard is inserted, users will be able to review patient data stored on the card on the PIC display.

See chapter 12 in the *PIC System User Instruction Manual* for instructions on how to use this option.

Press **EXIT** to return to the Recorder Configuration menu.

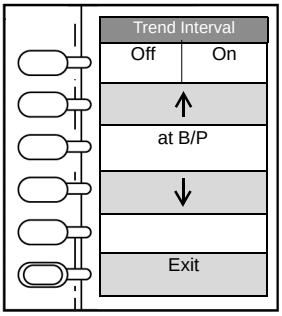
Trend Menu

Use the Trend menu to record patient vital signs (BP, HR, OX, Temp, Resp, IBP) to the internal log and printer at every trend interval.

If set to **Off**, trend data will not be collected.

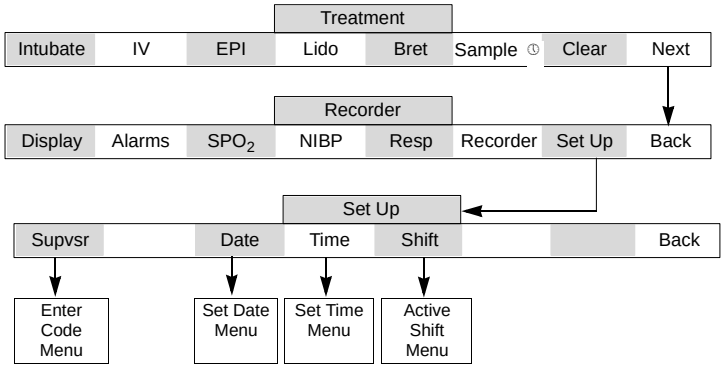
If set to **On**, a trend event will be generated at each elapsed time interval.

If set to **at B/P**, a trend event will be generated each time a BP reading occurs.

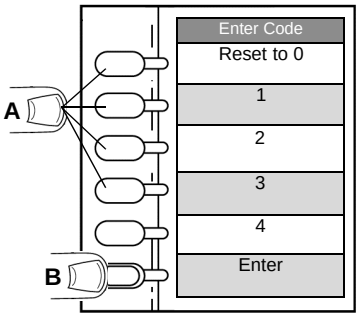


Press **EXIT** to return to the Recorder Configuration menu.

User Menus – Setup



Enter Code Menu

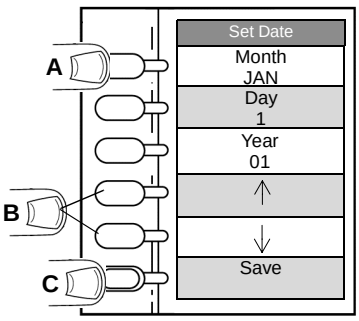


The default access code for entry to the Supervisor menus is 1, 2, 3, 4. Supervisors may change this code in the Supervisor Menus. Press a button to increment the corresponding digit (A). When all four digits are entered, press **ENTER** (B) to access the Supervisor menu. To reset the code, press the **RESET TO 0** button. The Lock ( ) icon on the Supervisor menu title block will open ( ) when the correct code is entered. If the wrong code is entered the" " will remain locked.

NOTE: If the code is lost, contact your MRL authorized service representative.

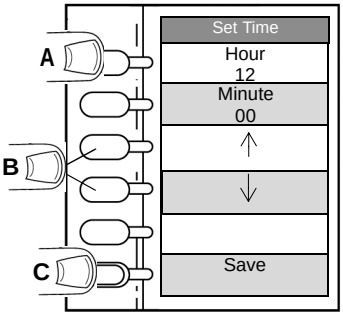
Set Date Menu

To select the month option, press the corresponding button (A). A bold outlined box indicates the selected option. Press the **UP** or **DOWN** arrow buttons (B) to select a specific month. Follow the same procedure to set the day and year. When finished, press **SAVE** (C).



Set Time Menu

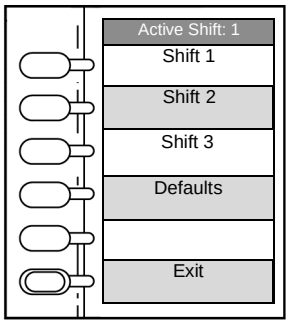
To select the hour option, press the corresponding button (A). A bold outlined box indicates the selected option. Press the **UP** or **DOWN** arrow buttons (B) to select the hour. Follow the same procedure to set the minute. When finished, press **SAVE** (C).



Active Shift Menu

The Active Shift menu allows the user to select predetermined shift settings options established by the supervisor. This option enables the user to save the user configurable menu items as shift 1, 2, or 3. Press the corresponding button to activate shift 1, 2, or 3. Then press **EXIT** to change to the settings for the selected shift settings.

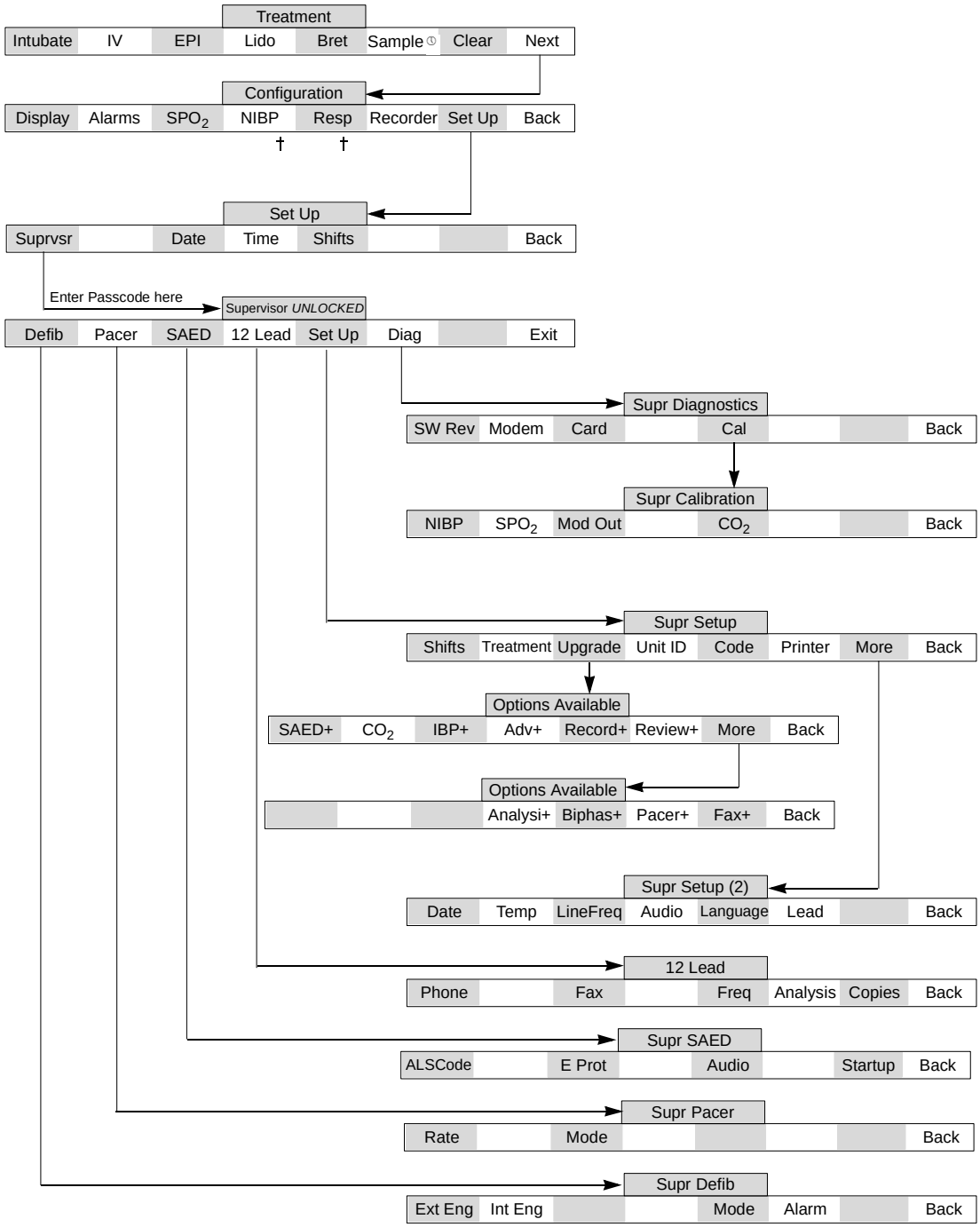
Refer to Supervisor Menu - Setup/Active Shifts for additional information.



NOTE: An asterisk next to a shift number indicates the settings for that shift have been saved.

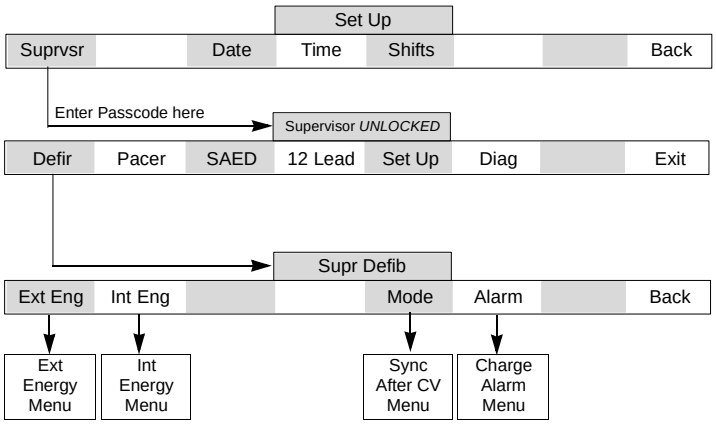
Supervisor Menus

The Supervisor menus are only available to a supervisor after the successful entry of the supervisor passcode. Using these menus, a supervisor can configure the installed options. The following diagram shows the structure of each Supervisor menu. This section explains how to access and configure the Supervisor menu options.



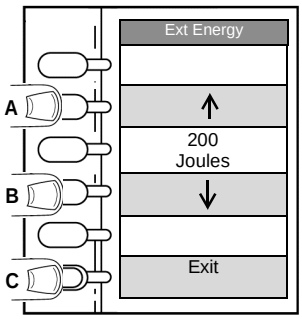
Supervisor Menus – Defibrillator

A supervisor can configure the defibrillator external, internal, and sync settings from the Defibrillator menu. This menu is accessible through the Treatment/Configuration/Set Up menus.

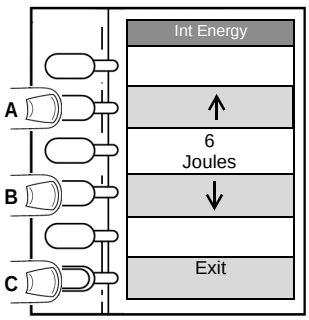


External Energy Menu

The Ext (External) Energy menu sets the default energy selected when the PIC is first turned on. The selected setting displays in this menu. To change the setting, press the **UP** arrow (A) or **DOWN** arrow (B) to increase or decrease the selection. Options are 2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, or 360 joules. Press **EXIT** (C) to return to the Defibrillator (Supr Defib) menu.



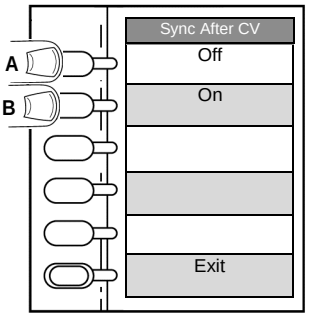
Internal Energy Menu



The Internal Energy menu sets the default internal energy selected when the PIC is first turned on or when internal paddles are first attached. The selected energy setting displays in this menu. To change the setting, press the **UP** arrow (A) or **DOWN** arrow (B) to increase or decrease the energy selection. Options are 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, or 50 joules. (To prevent possible cardiac tissue damage, the energy output is limited to 50joules.)

Press **EXIT** (C) to return to the Defibrillator (Supr Defib) menu.

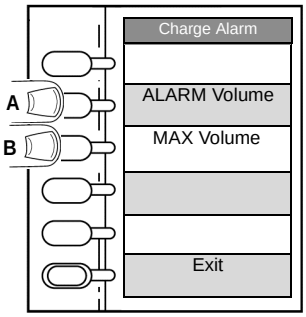
Sync After CV Menu



The Sync after CV (cardioversion) menu allows the user to configure the defibrillator to stay in the sync mode after each synchronized cardioversion. If this option is **Off** (A), the defibrillator will revert to the asynchronous mode. If this option is **On** (B), the defibrillator will remain in the Sync mode after each cardioversion.

Press **EXIT** to return to the Defibrillator (Supr Defib) menu.

Charge Alarm Menu

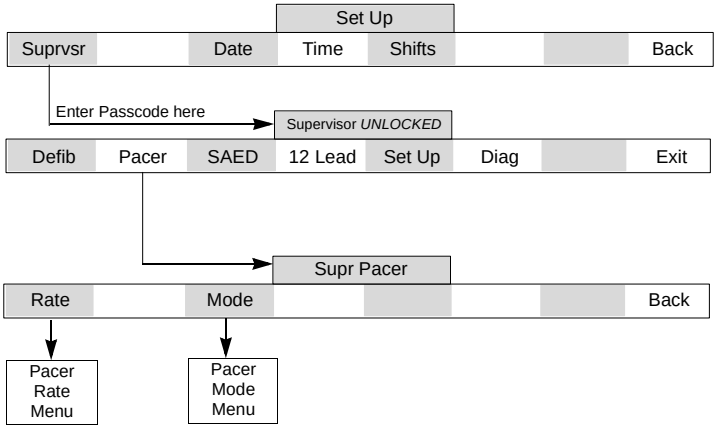


The Charge Alarm menu allows the user to select the Charge Alarm volume setting. Press the **ALARM VOLUME** button to use theVolume icon in the Quick Access window to adjust the charging tone. Press the **MAX VOLUME** button to set the charging tone to the maximum volume and by-pass the Volume icon.

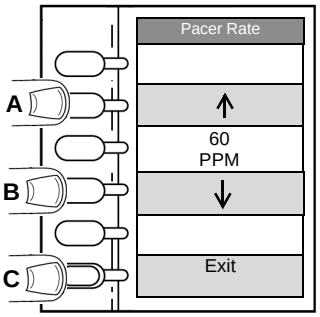
A bold, outlined box indicates the selected option. Press **EXIT** (C) to return to the Defibrillator (Supr Defib) menu.

Supervisor Menus – Pacer

The Supervisor/Pacer menu is used to configure the power on mode and initial rate. This menu is accessible through the Treatment/ Configuration/Set Up menus.

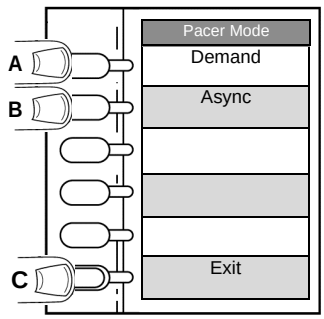


Pacer Rate Menu



Use the Pacer Rate menu to set the power on pacer rate setting. The range is from 30 to 180 PPM's. Press the **UP** arrow (A) or **DOWN** arrow (B) button to increase or decrease the pulse per minute (PPM) selection. Press **EXIT** (C) to close Pacer Rate menu.

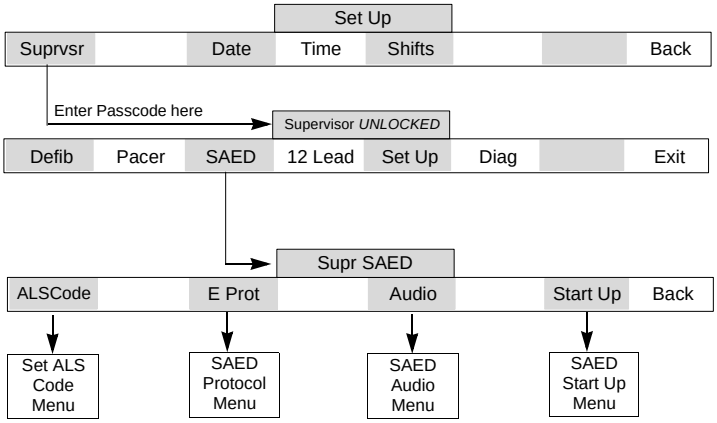
Pacer Mode Menu



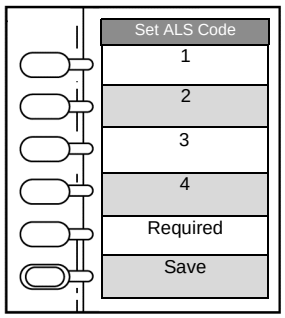
Use the Pacer Mode menu to set the power-on pacing mode. Press the **DEMAND** (A) or **ASYNC** (B) button. If Demand is selected, the PIC will supply pacing as needed. If Async is selected, the PIC will provide continuous pacing. A bold outlined box indicates the selected option. Press **EXIT** (C) to close Pacer Mode menu.

Supervisor Menus – SAED

The supervisor can use the SAED Menu to change the SAED configuration settings. This menu is accessible through the Treatment/Configuration/Set Up menus.

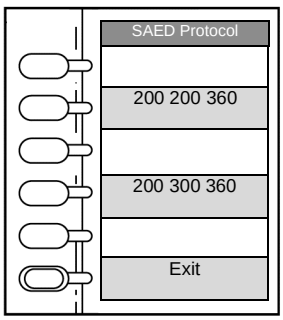


Set ALS Code Menu



The supervisor may use this menu to setup a separate pass code that allows ALS personnel to enter the Manual Defib mode from the SAED mode.

SAED Protocol Menu



Use the SAED Protocol menu to select an energy protocol. Press a corresponding button to select an option, then press **EXIT** to save the setting.

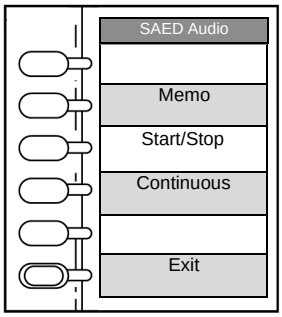
SAED Audio Menu

Use the SAED Audio menu to select a Voice Memo option:

Memo: User must press and hold the Memo button to record audio. Recording will end when button is released.

Start/Stop: User must press the Memo button to record audio. Recording will end when button is pressed again.

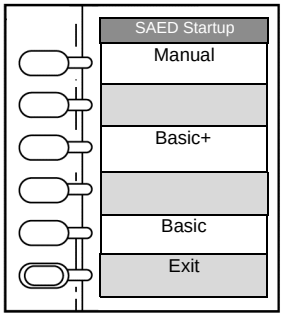
Continuous: Recording will start when the PIC is turned on if a data card is inserted.



SAED Startup Menu

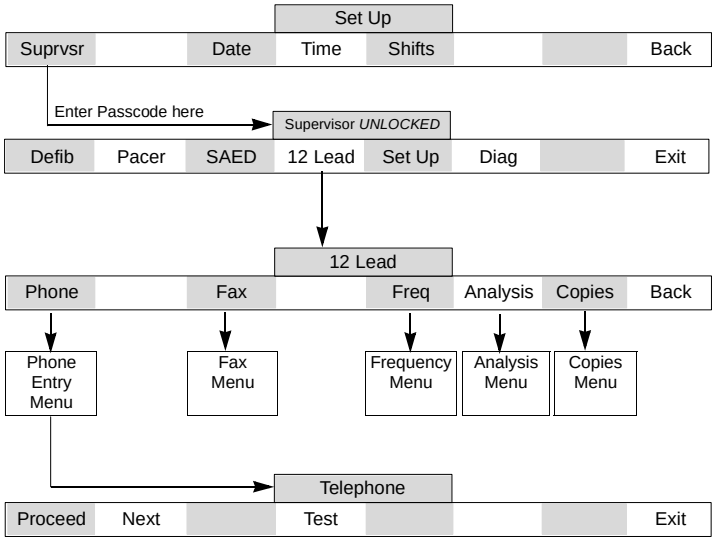
Use the SAED Startup menu to select either Manual, Basic+, or Basic as the PIC startup option. Your selection will be in effect the next time the is started.

NOTE: The ALS supervisor passcode must be entered to go from Basic+ or Basic mode to Manual mode.

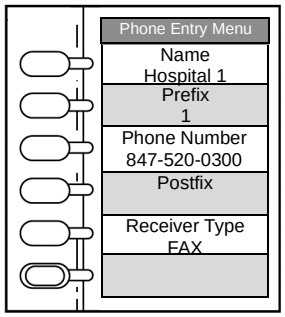


Supervisor Menus – 12-Lead

A supervisor can configure options that are specific to collecting and transmitting 12-lead data. These options include telephone and fax numbers, the number of printout copies produced, and frequency and analysis settings. This menu is accessible through the Treatment/ Configuration/Set Up menus.

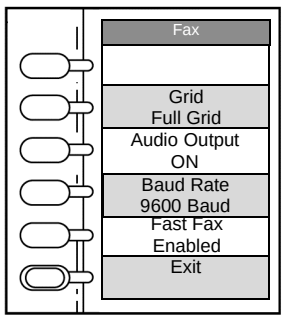


Phone Entry Menu



The Phone Entry menu allows the operator to add, edit, or delete up to 16 telephone numbers that can be used to transmit 12-lead data. Once selected, a telephone-specific menu, located along the bottom of the display area, is available.

Fax Menu



The Fax menu controls the output of the fax display for the 12-lead data.

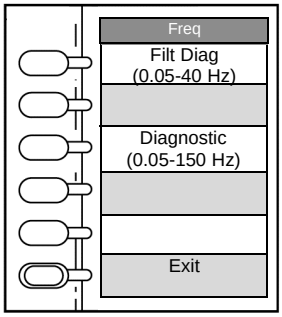
Grid: Full grid (default setting) provides grid masks every 0.2 cm. Partial grid (alternative setting) provides grid masks every 1.0 cm and reduces fax transmission time by as much as 30 seconds.

Audio Output: If hardware is installed, **On** (default) enables and **Off** disables Fax audio output during dialing and negotiating phases.

Baud Rate: Affects the fax transmission time. Select a rate that will work with your cellular service; 2400, 4800, 7200, and 9600 (default) available.

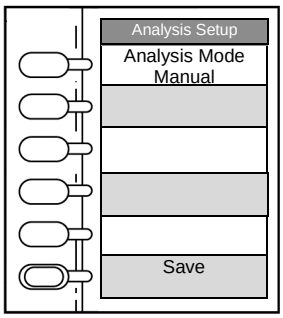
Fast Fax: Disabled is the default. When enabled, only 1 lead of the real-time ECG trace displays and transmission time decreases.

Freq Menu



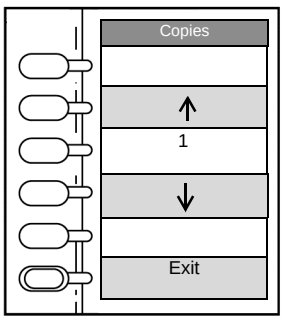
The Freq menu controls the Rolloff Filter used when acquiring a 12-lead snapshot. The Freq Menu only affects the real-time display and the acquired signal.

Analysis Setup Menu



The Analysis Setup menu is used to select the Automatic or Manual modes for conducting an analysis of 12-lead input. In Automatic mode, the analysis begins immediately after the data is collected. In Manual mode, the operator must initiate the analysis after the data is collected.

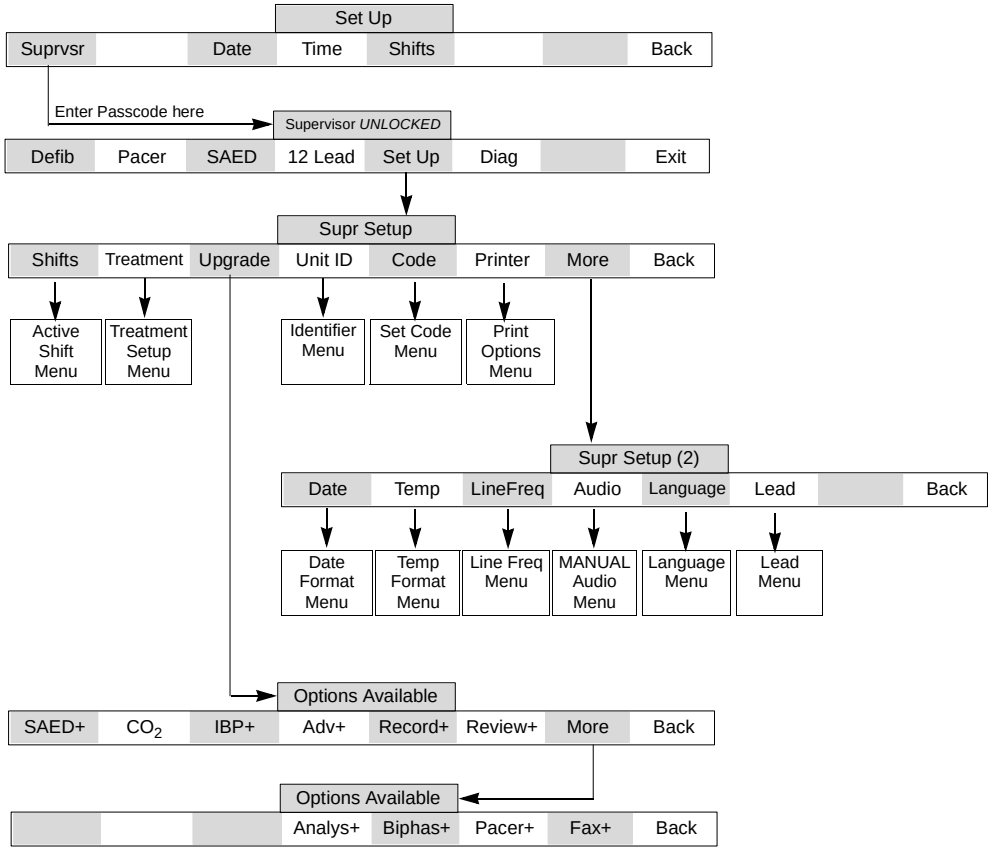
Copies Menu



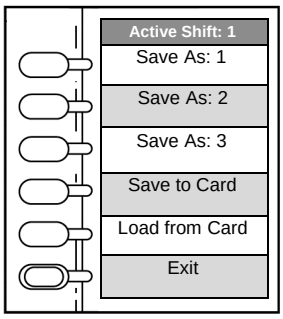
The Copies menu controls how many printed copies of the 12-lead data will be produced when the print icon button is pressed.

Supervisor Menus – Setup

Supervisors are able to access and change the options in the Set Up menus. The date format, language, and the supervisor entry passcode are examples of options that supervisors can configure from these menus.

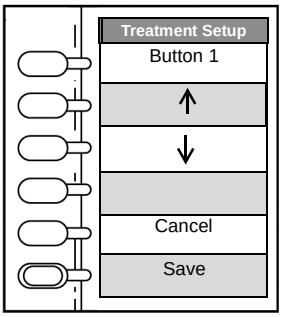


Active Shift Menu



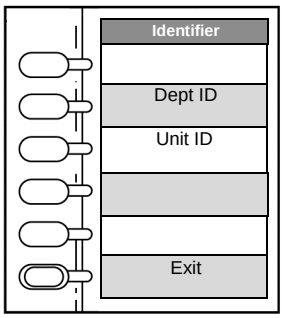
The Active Shift menu allows the supervisor to select and save PIC configurations for use by specific shift. It also allows loading from and saving the log to a memory card.

Treatment Setup Menu



The Treatment Setup menu allows the supervisor to choose and customize the bottom treatment summary/menu window buttons. Press the **UP** and **DOWN** arrow buttons to scroll through the available options.

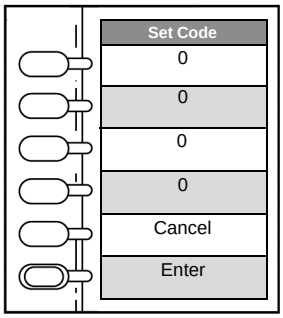
Unit ID



The Unit ID menu allows the supervisor to set unit and department IDs. This information is printed in the "System On" heading on the chart recorder.

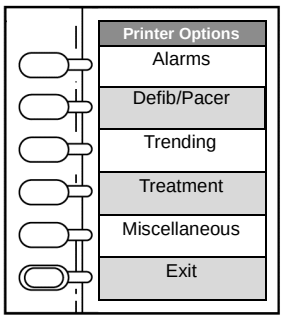
Set Code Menu

The default access code for accessing the supervisor menus is 1, 2, 3, 4. To set a new supervisor code, enter a number of your choice, 0-9, in all four number areas. Press **CANCEL** to cancel the number code selection. Press **ENTER** to save the new code.



NOTE: Be sure to write down the new supervisor passcode and store it in a safe place.

Printer Options



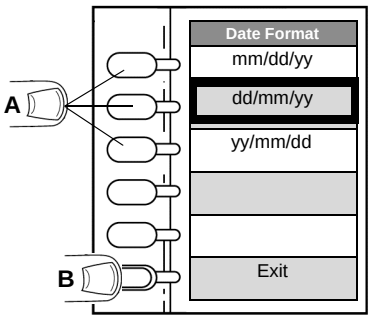
The Printer Options menu allows the supervisor to control the printout information on the chart recorder. Turn an option On to include it in the printout. Turn an option Off to exclude it from the printout (but it will be sent to the log).

Date Format Menu

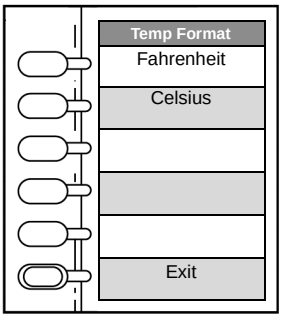
Use this menu to set the date format for displaying the month, day, and year:

mm/dd/yy = month/day/year
dd/mm/yy = day/month/year
yy/mm/dd = year/month/day

To select a format, press the corresponding button (A), then press Exit (B).

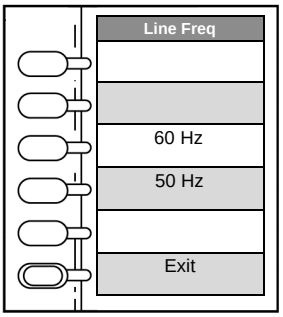


Temp Format Menu



Temperatures readings can be set to display in Fahrenheit (°F) or Celsius (°C). Press the corresponding Fahrenheit or Celsius button to select an option. A bold outlined box indicates the selected option. Press **EXIT** to return to the Supervisor Calibration menu.

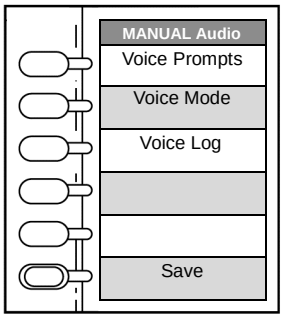
Line Freq Menu



The Line Frequency menu allows the supervisor to choose the desired line frequency, either 50 or 60 Hz.

Press **EXIT** to return to the Supervisor Calibration menu.

Manual Audio Menu

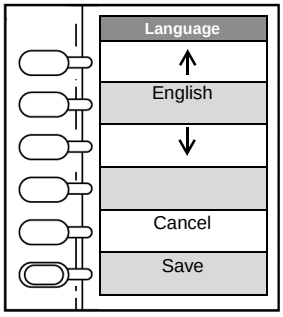


Use the Audio menu to select the voice prompts, voice memo, and voice log modes. These options are only available if purchased.

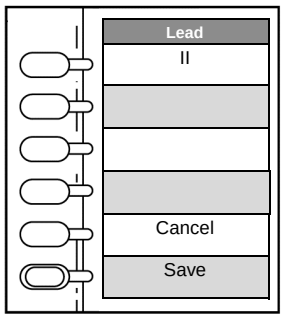
Press **EXIT** to return to the Supervisor Calibration menu.

Language

The Language menu allows the supervisor to select the language used in the display. The available languages are English, Spanish, French, German, Portuguese, and Italian. To change a language selection, press the arrow buttons to change the language, then press Save. Turn the PIC off, then restart it to activate the language option.



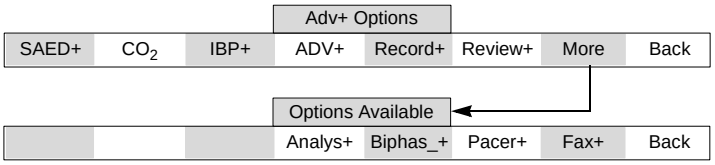
Lead Menu

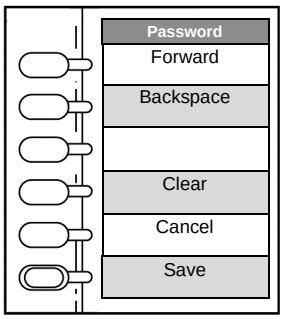


The Lead menu allows the supervisor to change the default lead displayed on start-up.

Upgrade Password Menu

The Upgrade menu allows the addition of options to the PIC System in the field. Contact your MRL customer service representative for instructions on upgrading the PIC System.





ENTERING THE UPGRADE PASSWORD

The Password menu gives the operator the option of moving the cursor forward or backward; or clearing, canceling or saving the entry. Follow these instructions to upgrade the password.

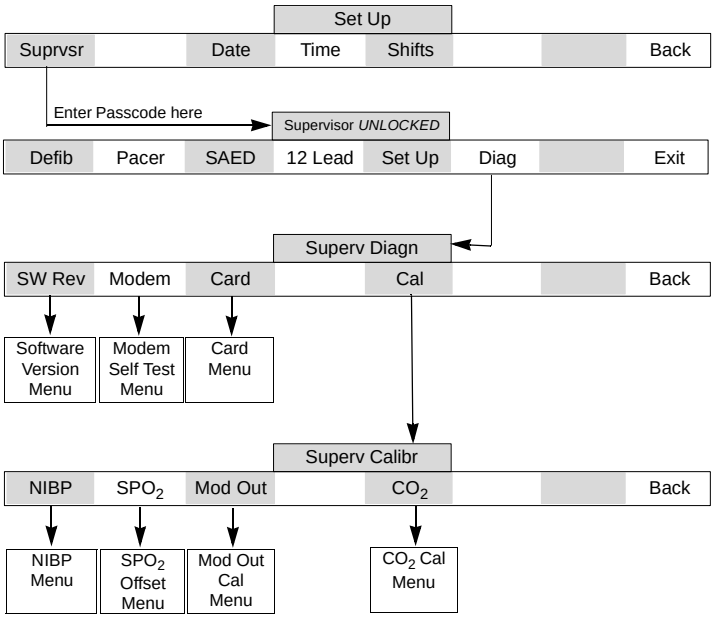
1. Enter a new character by pressing once on the group of characters containing the character of your choice (B). (In this case we want to change the "1" to a "0").

NOTE: The upgrade menu window is replaced by a numeric window. The password is displayed just above the numeric window with an active cursor in the first space.

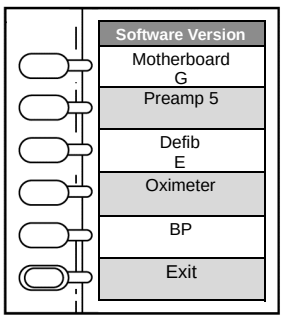
2. Press on the actual character (C). Your selection will be entered and the cursor will move to the next character in the identifier. Continue this process to complete the password.

3. Press the **SAVE** button in the Password menu to save the selection and return to the Upgrade menu. A "+" symbol should now appear after Adv, indicating that the option was successfully installed.

Supervisor Menus – Calibration

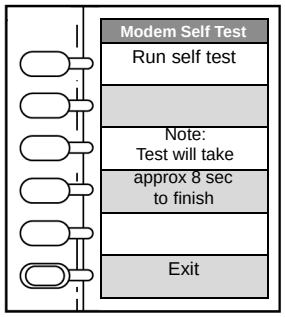


Software Version Menu



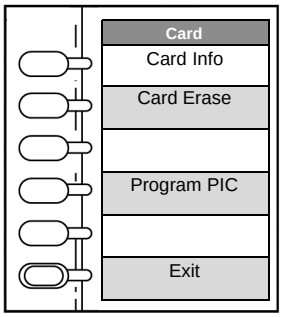
The Software Version menu provides information about the software installed for the motherboard, preamp, defibrillator, oximeter, and blood pressure board.

Modem Self Test



The Modem Self Test menu allows the supervisor to run a modem self test.

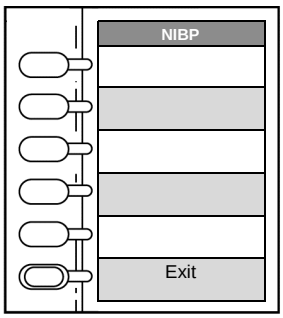
Card Menu



From the Card menu, the supervisor can get information about the memory card (size, type, contents, format count, and format date), erase the memory card, and program the MRL PIC from a programmable card.

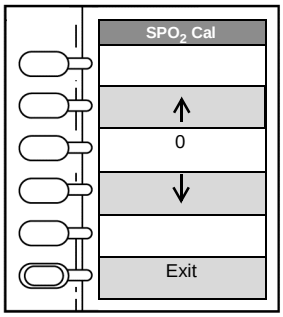
NIBP Cal Menu

The NIBP Calibration menu is used by authorized service personnel to calibrate the PIC blood pressure measurement capabilities.



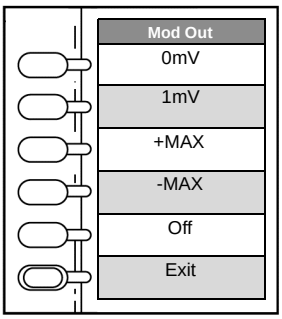
WARNING: This menu should be used only by authorized service personnel. DO NOT attempt to calibrate the blood pressure when the PIC System is being used on a person.

SPO_2 Cal Menu



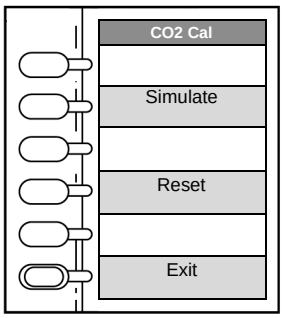
From the SPO_2 Cal menu, the supervisor can test the DC output gain. For every 1 mV on the ECG, there should be one volt of DC output. Press the up/down arrow buttons to select a bias calibration. The options are 0, 1, or 3.

Mod Out Cal Menu



From the Mod Out Cal menu, the supervisor can

CO_2 Cal Menu



From the CO_2 menu, the supervisor can check the CO_2 calibration based on a 40 mmHg simulated trapezoidal signal.

CHAPTER 4: MRL LITE PROGRAM MENU SETUP

This chapter lists the MRL LITE menu options and structure. It provides the menu setup descriptions for both the user and supervisor menus.

Chapter Overview:

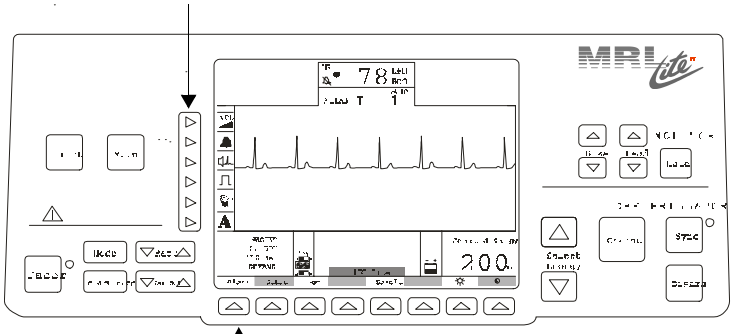
- *MRL Lite Menu Structure 4.1*
- *Basic Menu Structure. 4.3*
- *MRL Lite Menus. 4.4*
- *Setup Menus 4.8*
- *ECG Configuration Menu. 4.10*
- *Supervisor Menus 4.12*
- *Supervisor – Defibrillator Menu 4.13*
- *Supervisor – Pacer Menu (optional) 4.15*
- *Supervisor – Diag Menu 4.16*
- *Supervisor – Setup Menu 4.17*
- *Supervisor – Upgrade Menu 4.19*

MRL Lite Menu Structure

The MRL Lite System uses a modified version of the PIC User and Supervisor menus described in Chapter 3.

The MRL Lite Menu structure consists of four menu options and the controls used to adjust the display area brightness and contrast. The MRL Lite Menu is located along the bottom of the MRL Lite display area, as shown in the following diagram.

Quick Access buttons - select a menu button option, then press these buttons to use the programmable menus



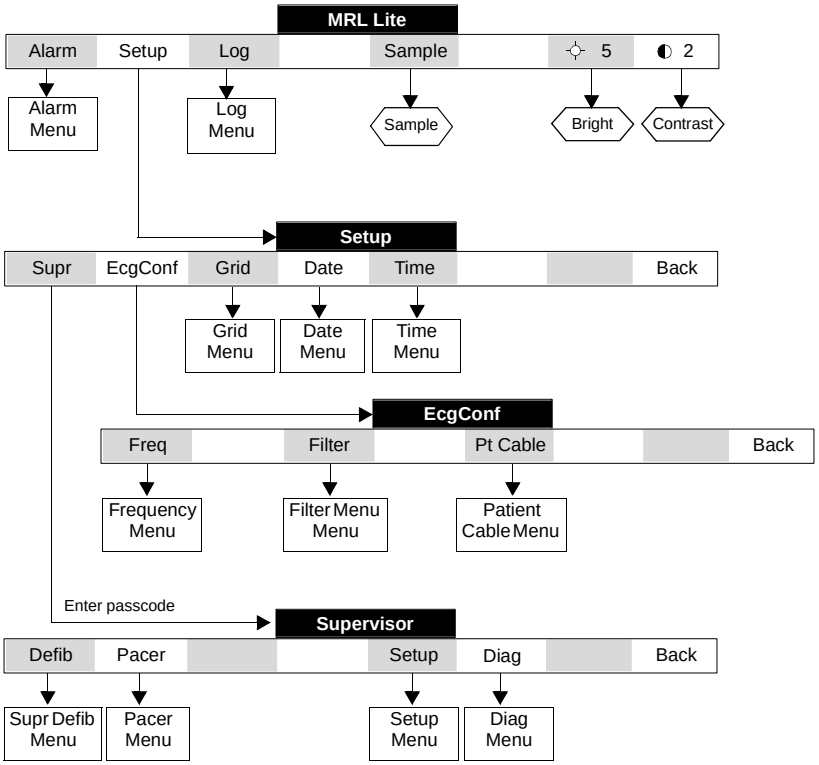
Menu buttons - press to select and display a programmable menu.

- Press a Menu button to select or activate a menu option and display the associated programmable menu along the left side of the display area.
- Press a Quick Access button, located to the left of the display area, to select or activate the a programmable menu option.

Basic Menu Structure

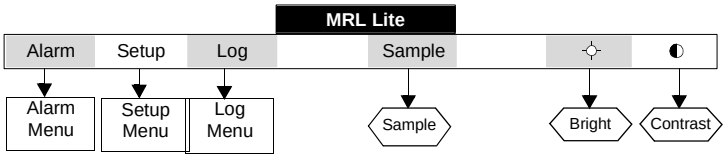
The basic MRL Lite Menu options display at system startup and are used to set up many of the system functions, including:

- Alarm
- Setup
- Log
- Sample
- Brightness
- Contrast

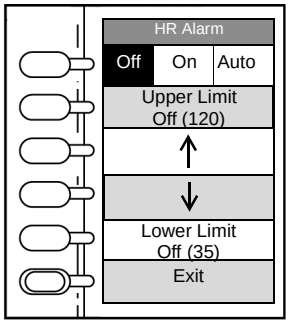


MRL Lite Menus

The MRL Lite Menu options are available to all users. Supervisor menus can only be accessed after entering the supervisor passcode.

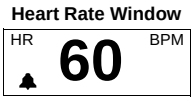


Alarm Menu

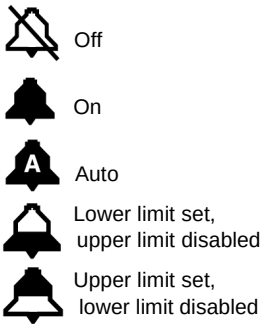


Use the Alarm menu to set the heart rate (HR) alarm. The alarm options are Off, On, or Auto. Press the Alarm menu button to display the HR Alarm menu. Press a Quick Access button to change a setting.

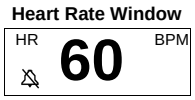
In this example, the alarm is off, the upper limit setting is 120, and the lower limit setting is 35.



If the alarm is set to On or Auto, the alarm icon that corresponds to the option you set will appear in the Heart Rate window of the display. The icon indicates the current alarm settings. The alarm will activate when the patient's heart rate exceeds the upper and/or lower limit set in this menu option.



NOTE: In either On or Auto mode, an audible tone will sound and the patient's heart rate measurement will flash in the heart rate window if the alarm parameters have been exceeded.



When the alarm is set to Off, the upper and lower limits will include the word Off and a number in parentheses. The number indicates the currently set HR limit that will be active when the HR alarm is turned to On or Auto.

TURNING OFF THE HR ALARM

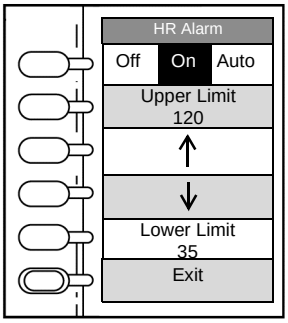
1. Press the **OFF/ON/AUTO** Quick Access button until Off is highlighted.

   The word Off will appear in front of the upper and lower limit on the Quick Access menu. The number in the parenthesis indicates the currently set HR limit. This setting will be active when the HR Alarm is turned on.

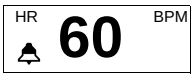
2. Press **EXIT** to leave the menu.

TO TURN ON THE HR ALARM OPTION:

1. Press the **OFF/ON/AUTO** Quick Access button until On is highlighted.
2. Press the **UPPER LIMIT** button to activate this option and highlight it with a bold box.
3. Press the **UP**/**DOWN** buttons to increase or decrease the upper limit setting.



Heart Rate Window



NOTE: To disable the upper limit option, press the Upper Limit button a second time. The word Disabled will display instead of a number.

If the upper limit option is set, the lower limit option must be disabled. If the lower limit option is selected, the upper limit option must be disabled.

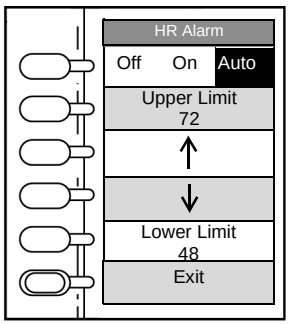
4. Press the **LOWER LIMIT** button to activate this option and highlight it with a bold box.
5. Press the **UP**/**DOWN** buttons to increase or decrease the Lower Limit setting.

NOTE: To disable the upper limit option, press the Upper Limit button a second time. The word Disabled will display instead of a number. If the upper and lower limits are set, the Alarm On icon ( ) will appear in the HR window and the global alarms will be enabled.

6. Press **EXIT** to enable the settings and return to the the MRL Lite Menu.

TURN ON AND SET THE AUTO HR ALARM

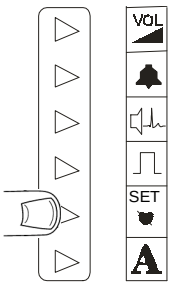
1. Press the **OFF/ON/AUTO** button until Auto is highlighted.The auto alarm icon (A) will appear in the HR window and the global alarms will be On.



NOTE: The upper and lower limits will be undetermined if a valid ECG is not present.

2. Press **EXIT** to save the setting and leave the HR Alarm menu.

3. Press the quick access **AUTO** button next to the set icon to set the automatic HR Alarm limits. The patient's heart rate at the moment the button was pressed, will appear above the heart icon in the display area.



Heart Rate Window

The HR Alarm monitor automatically sets the upper and lower heart rates limits at +/- 20% of that heart rate set point or +/-10 beats whichever is greater.

Each press of the **AUTO** button will adjust the heart rate set point and reset the auto HR alarm limits.

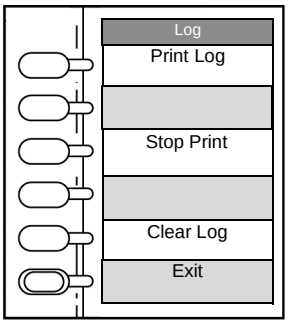
You can view the upper and lower limits that were set by going back to the HR Alarm menu. The undetermined upper and lower limits have been replaced with automatically set values.

Setup Menu

See the Setup menu section in this chapter for information about the Setup menu options.

Log Menu

Use the Log menu to print the log, stop print of log, or clear the log. Press **LOG** to enter the Log menu and make your selection. Press **EXIT** to close the Log menu.



Press **STOP PRINT** to stop printing the Event Log. The information in the log will not be affected.

Press the **CLEAR LOG** button to clear the Event Log .

NOTE: To prevent a previous patient's Event Log data from being printed with a new patient's data, always clear the log prior to treating a new patient.

Sample

Press the **SAMPLE** button to store a 4 second ECG internally and print a sample ECG. The sample from the chart recorder will print the words "Sample Event" on the chart along with a 6 second ECG.

Bright

Press the **BRIGHT** button to brighten the display area. There are five brightness settings. The current brightness setting is displayed on the menu. Each press of the button increases the brightness of the display, once the highest brightness setting (5) is reached the next press of the button returns the brightness setting to the lowest setting (1).

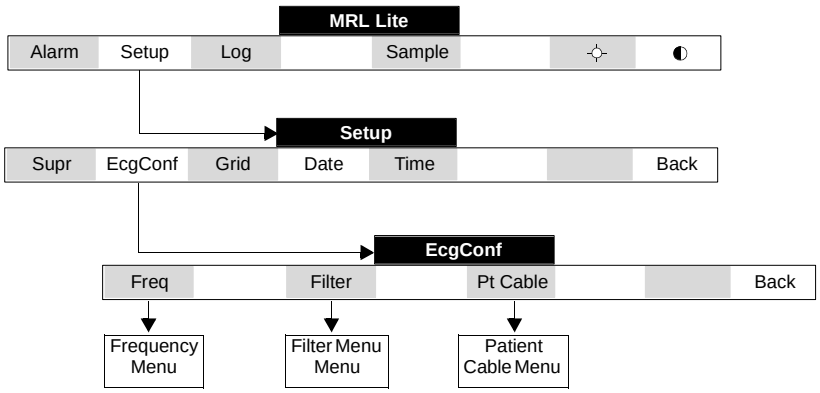
Contrast

Press the **CONTRAST** button to add contrast to the display. There are nine contrast settings. The current contrast setting is displayed on the menu. Each press of the button increases the contrast of the display, once the highest contrast setting (9) is reached the next press of the button returns the contrast setting to the lowest setting (1).

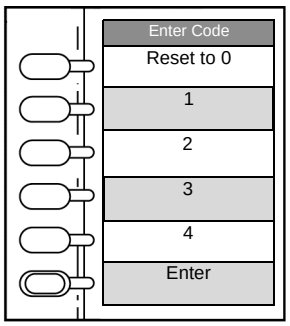
Setup Menus

The MRL Lite has several user-defined options that may be set or selected from the Setup menus. Access to the Setup menus is through the MRL Lite/Setup option.

From the Setup menus, users can access the Supervisor menus, set the ECG Configuration options, choose to print a grid on the chart recorder paper, and set the current date and time.



Enter the Supervisor Passcode



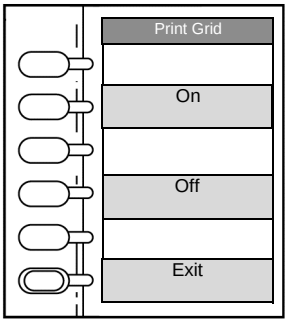
Use the Enter Code menu to access the Supervisor menus. Press **RESET TO 0** to prepare the system for a new access code. Press a button to increment the corresponding digit. When all four digits are correct, press **ENTER**. The Lock (🔒) icon on the Supervisor menu title block will open (🔓) when the correct code is entered.

NOTE: The default access code for entering the supervisor menus is 1,2,3,4. This code may be changed by the supervisor. Write down the new supervisor code and store it in a safe place. If the code is lost, contact your MRL authorized service representative.

ECG Configuration

See the ECG Configuration section in this chapter for information on the ECG Configuration menus.

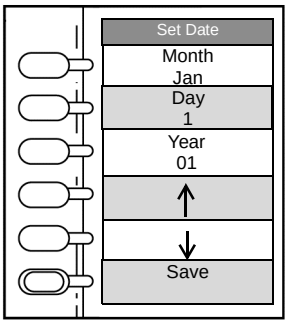
Print Grid Menu



Use the Print Grid menu choose to print a grid on the chart recorder paper. If the Print Grid option is On, the chart recorder will print a grid on plain white paper.

Press the corresponding button to select an option. A bold outlined box indicates the current selection. Press **EXIT** to return to the Setup menu.

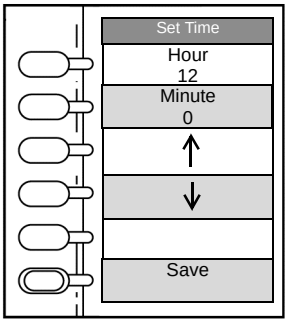
Set Date Menu



Use the Set Date menu to set the current date. To select the correct month, press the **MONTH** button. A bold outlined box will appear around the month window. Press the **UP**/ **DOWN** arrow to toggle through the months until the desired month displays.

Repeat this procedure to set the day and year. When finished, press **SAVE**.

Set Time Menu



Use the Set Time menu to set the current time. To select the correct time, press the **HOUR** button. A bold outlined box will appear around the hour window. Press the **UP**/ **DOWN** arrow buttons to toggle through the hours until the desired hour displays.

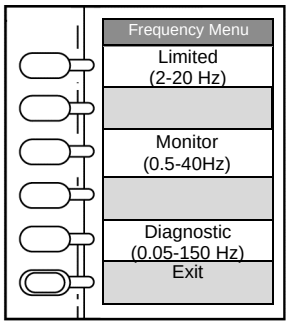
Repeat this procedure to set the minute option. When finished, press **SAVE**.

ECG Configuration Menus

Access to the ECG Configuration menus and options is through the MRL Lite and Setup menus. Use the ECG Configuration menu to set the frequency response, line filter, and select the patient cable type.

Frequency Response (Freq) Menus

There are three frequency response options: Limited, Monitor, and Diagnostic.

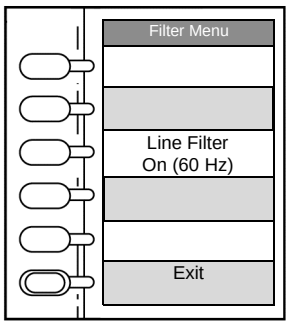


- Limited is automatically selected for paddle monitoring application.
- Monitoring is recommended for general ECG monitoring applications.
- Diagnostic should be used when attempting to interpret subtle ECG changes (ST segments). For optimal diagnostic response, the line filter should be turned Off.

NOTE: Limited response is available only when lead select is set to PDL. Monitor and Limited responses are available only when the lead select is set to PADS.

The frequency response selection sets the display and the chart recorder response. Press the corresponding button to choose a frequency. A bold outlined box indicates the selected frequency. Press **EXIT** to close the Frequency Response menu.

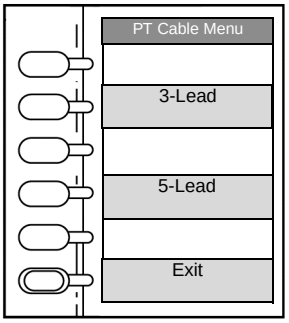
Filter Menu



Line filters remove AC (mains) line interferences emitted from power lines and other electrical apparatus. The line filter state, On or Off, and the line filter frequency (selected in the supervisor menu) display on this menu.

Press the quick access button from the Filter menu to turn the line filter option on or off. Press the corresponding quick access button to. Press **EXIT** to return to the ECG Configuration menu.

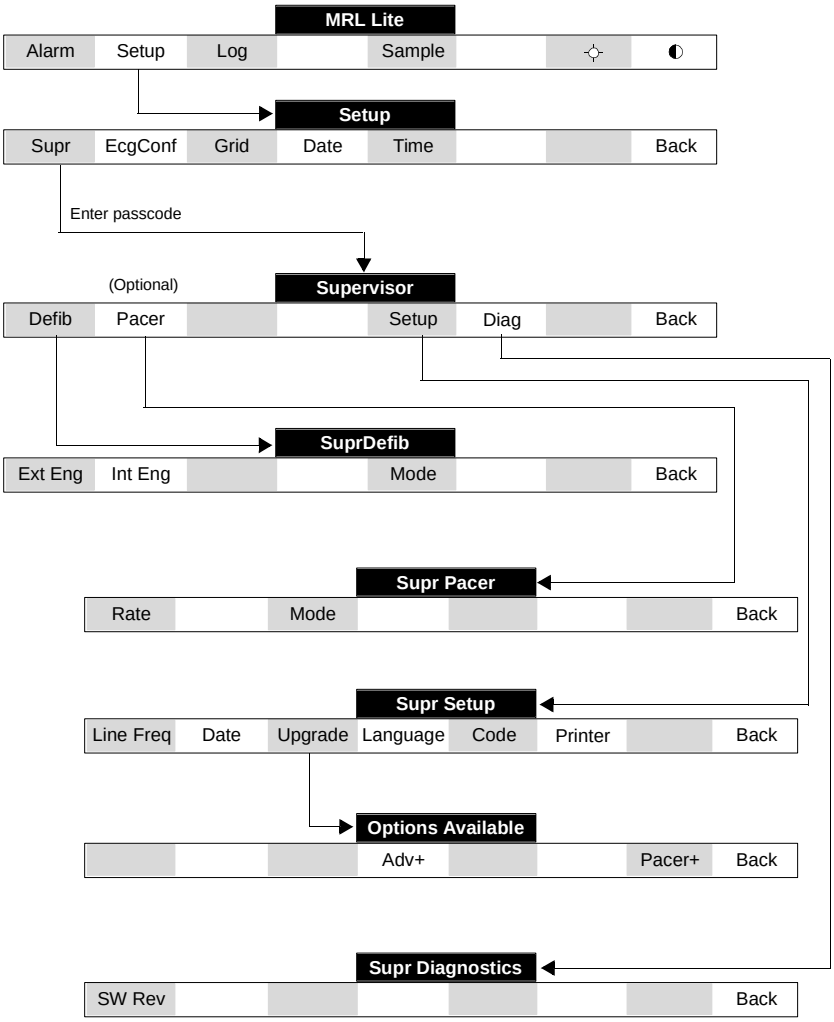
Patient Cable (Pt. Cable)



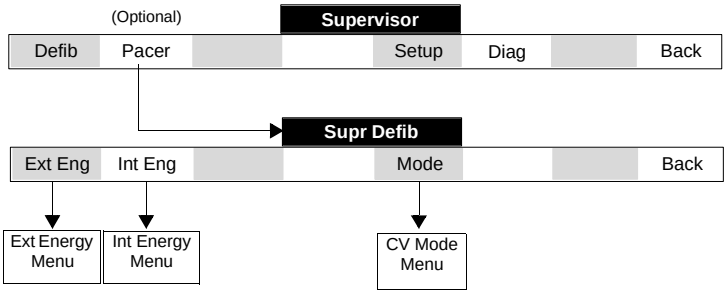
Use the Patient Cable menu to choose a 3-lead or 5-lead patient cable. If the patient cable inserted into the MRL Lite does not match the patient cable configuration selected, a lead fault alarm may sound.

Press the corresponding quick access button to choose a different lead configuration. A bold outlined box indicates the selected lead configuration. Press **EXIT** to return to the ECG Configuration menu.

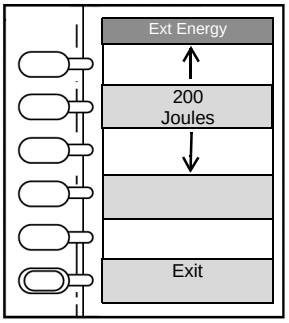
Supervisor Menus



Supervisor – Defibrillator Menu



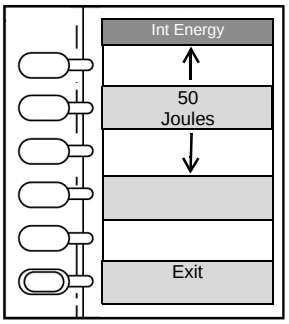
External Energy



Use the External Energy menu to select the default energy setting that will be active when the MRL Lite is first turned on with external paddles connected. The default selected energy setting is displayed in this menu. The options are 2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, or 360 Joules.

To change the default energy setting, press the **UP** arrow to increase and the **DOWN** arrow to decrease the energy selection. Press **EXIT** to return to the Supervisor menu.

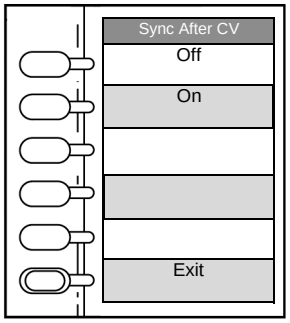
Internal Energy



Use the Internal Energy menu to select the default internal energy setting that will be active when the MRL Lite is first turned on without paddles or when internal paddles are first attached. The current selected default energy setting is displayed in this menu. The options are 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, or 50 Joules. (To prevent possible cardiac tissue damage, the energy output is limited to 50 Joules.)

To change the default energy setting, press the up arrow to increase or the down arrow to decrease the energy selection. Press **EXIT** to return to the Supervisor menu.

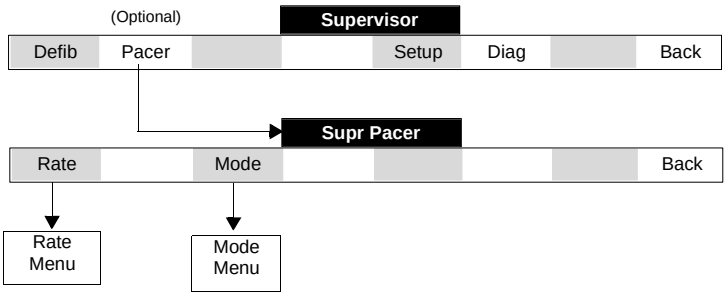
Sync After CV



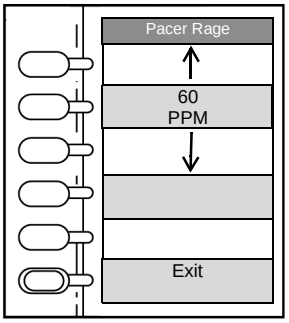
Use the Sync After CV (cardioversion) menu to configure the defibrillator to stay in the sync mode after each synchronized cardioversion. If this option is Off, the defibrillator will revert to the Asynchronous mode. If the option is On, the defibrillator will remain in the Sync mode after each cardioversion.

Press a button to select an option. A bold outlined box indicates the selected option. Press **EXIT** to return to the Supervisor menu.

Supervisor – Pacer Menu (optional)



Rate Menu

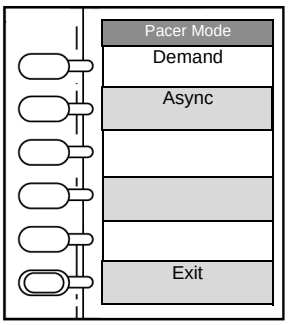


Use the Rate menu to set the default pacer rate setting. The range is from 30 to 180 PPM.

Press the **UP**/ **DOWN** arrow buttons to increase/decrease the pulse per minute (PPM) selection.

Press **EXIT** to close the Pacer Rate menu.

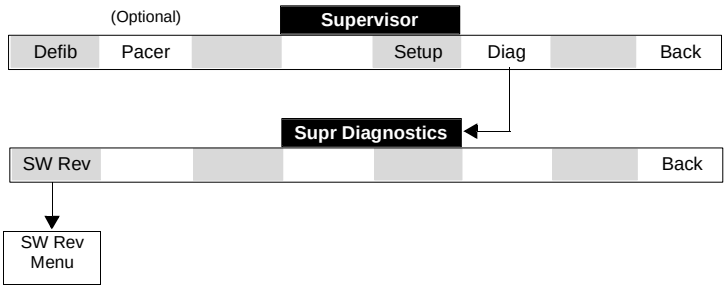
Mode Menu



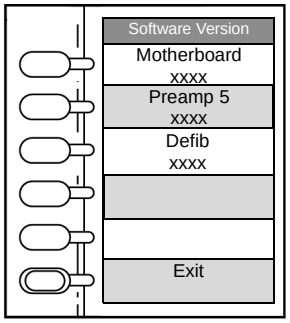
Use the Mode Menu to set the default pacing mode. The options are Demand or Async.

Press the corresponding option button. A bold outlined box indicates the selected option. Press **EXIT** to close the Pacer Mode menu.

Supervisor – Diagnostic Menu

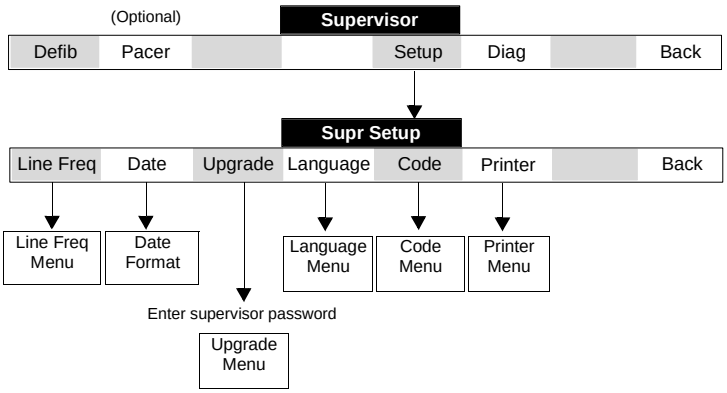


Software Rev Menu

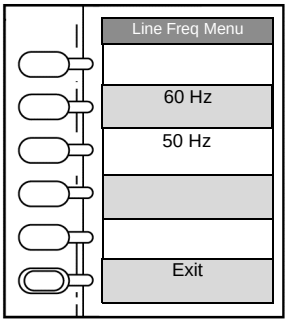


Use the Software Version menu to display system information including the current software version for the microprocessor in the MRL Lite.

Supervisor – Setup Menu



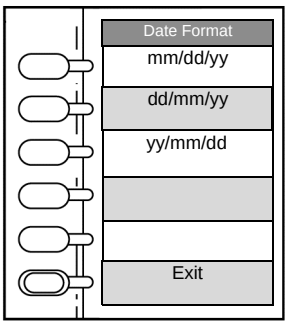
Line Frequency Menu



Use the Line Frequency menu to set the line frequency. The frequency must match the AC line current. In countries where the line current is 60 (i.e., USA), set the selection to 60 HZ. In countries where the line current frequency is 50 Hz, select 50 Hz.

Press the corresponding button to select an option. A bold outlined box indicates the selected option. Press **EXIT** to return to the Supervisor Setup menu.

Date Format Menu



Use the Date Format menu to select a format for the month, day and year. The format will be used each time the date is shown in the display area and on the printouts.

The date format options are:

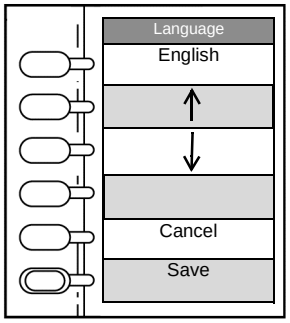
mm/dd/yy/ = month/day/year

dd/mm/yy = day/month/year

y y/mm/dd = year/month/day

Press the corresponding button to select a format. A bold outlined box indicates the selected option. Press **EXIT** to return to the Supervisor Setup menu.

Language Menu

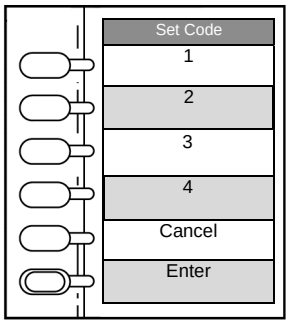


Use the Language menu to select the language that will be used in the display area and on chart printouts. The options are English, Spanish, German, French, Italian, and Portuguese.

Press the **UP**/**DOWN** arrow buttons until the language you want to use displays. Press **SAVE** to save your selection. The next time you start the MRL Lite, the selected language will be in effect.

NOTE: To restore the MRL Lite language setting to English, press the Mute and VOL buttons at the same time.

Code Menu

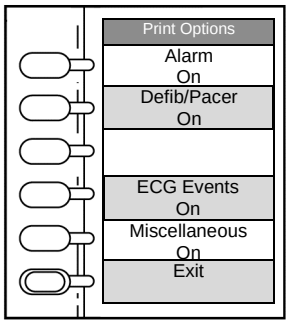


Use the Set Code menu to select the supervisor access code. The default code is 1, 2, 3, 4.

To set a new supervisor code, press a button to increment the corresponding digit until the number of your choice appears. The range for each digit of the code is 0-9. Press **CANCEL** to cancel the number code selection. Press **ENTER** to save the code.

NOTE: Remember to write down the new supervisor code and store it in a safe place.

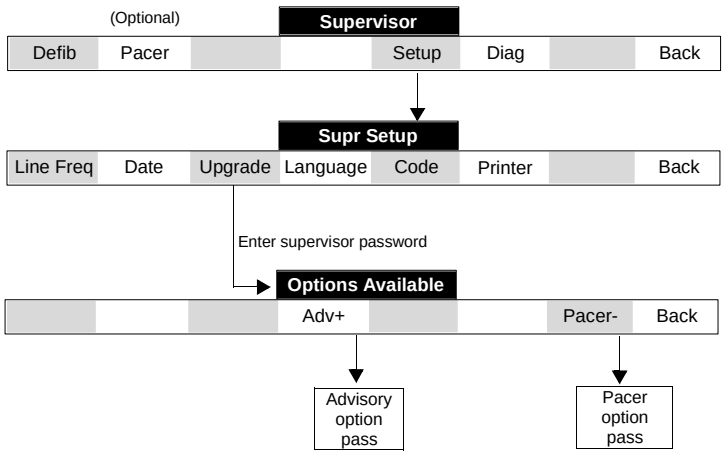
Printer Menu



Use the Printer menu to disable hardcopy printouts when specific events occur. ECG Events are events generated by when the Sample button is pressed. Miscellaneous events are system status events such as System On and Low Battery messages.

Select **OFF** to disable printouts at the time the event occurs. Chart printouts for these events can only be obtained when the event log is printed. Press **ON** to generate printouts when the event occurs and when the event log is printed.

Supervisor – Upgrade Menu

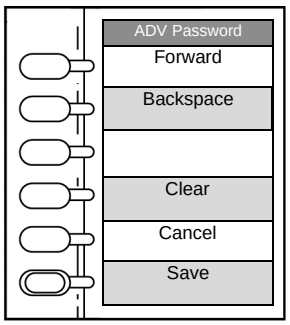


ADV Password Menu

The Advisory Password menu allows users to add options to an MRL Lite in the field. Contact your MRL customer service representative for instructions on upgrading an MRL Lite.

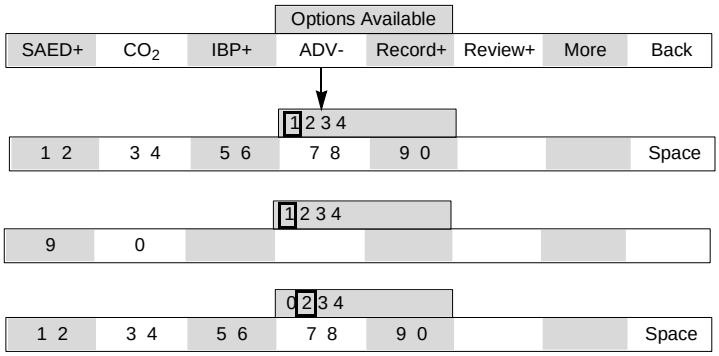
Entering the Upgrade Password

The Password menu gives the operator the option of moving the cursor forward or backward; or clearing, canceling or saving the entry. Follow these instructions to upgrade the password.



1. Enter a new character by pressing once on the group of characters containing the character of your choice.

NOTE: The Upgrade menu window is replaced by a numeric window. The password is displayed just above the numeric window with an active cursor in the first space.



2. Press the actual character. Your selection will be entered and the cursor will move to the next character in the identifier. Continue this process to complete the password.

3. Press the **SAVE** button in the Password menu to save the selection and return to the Upgrade menu. A "+" symbol should now appear after Adv, indicating that the option was successfully installed.

CHAPTER 5: PERFORMANCE TEST PROCEDURES

The following inspections and performance tests should be performed by qualified biomedical personnel at regularly scheduled intervals. Factors such as the frequency of equipment use or operational policy may dictate that these procedures be performed as often as every 90 or 180 days. In any case, the maximum interval should not exceed one year.

Chapter Overview:

- *Inspection Procedures 5.2*
- *Recommended Test Equipment 5.4*
- *Safety Testing 5.6*
- *ECG Monitor 5.7*
- *ECG Amplitude Calibration 5.9*
- *Heart Rate Display Accuracy 5.10*
- *Defibrillator 5.11*
- *Synchronized Discharge 5.13*
- *Transthoracic Pacemaker (if equipped) 5.14*
- *Advisory Option (if equipped) 5.15*
- *Battery Charger Test Procedure 5.16*
- *3-Volt Lithium Battery Check 5.17*
- *Battery Capacity Test and Reconditioning Procedure 5.18*
- *Guidelines for Maintaining Peak Battery Performance 5.20*
- *12-Lead ECG Data Acquisition and Fax Modem Test 5.21*
- *Non-Invasive Blood Pressure Performance Test 5.22*
- *Pulse Oximeter Performance Test 5.24*
- *IBP Performance Test 5.25*
- *CO_2 Performance Test 5.26*

Inspection Procedures

1. Inspect unit for wear

- Inspect the outer enclosure, integral handle, and display panel for cracks, chipping, or other obvious damage.
- Clean away any foreign materials.
- In cases where fluid contaminant is observed, verify that no corrosion of external or internal components has occurred.
- Replace any damaged component prior to returning the PIC to normal use.

2. Inspect external paddles

- Inspect for foreign material, especially in the area of the electrode plates and the shock buttons, where gel or fluid can accumulate.
- Check the electrode surfaces for pitting or deep scratches.
- Check the cable insulation for cuts or fraying.
- Check the connector end of the paddles for damaged or corroded connector pins.
- Check the latch for proper operation.
- Check for signs of heat damage, such as warpage or distortion of plastic parts, could indicate that the external paddles have been subjected to a sterilization process. If this type of damage is observed, PIC operators must be notified that the external paddles are not intended to be sterilized.
- Replace damaged external paddles prior to returning the PIC to normal use.

3. Inspect hands-free paddle cable

- Inspect the hands-free paddle cable for any signs of wear or damage, such as cuts or cracks in cable insulation, bending or corroding of connector pins, or heat-related damage that could indicate exposure to a sterilization process. If this type of damage is observed, PIC operators must be notified that the hands-free cable is not intended to be sterilized.
- Replace a damaged hands-free cable prior to returning the PIC to normal use.

4. Inspect internal paddle electrodes, paddle cable, and paddle adapter

- Inspect the internal paddle electrodes and cable for signs of damage or deterioration that can occur with repeated exposure to sterilization processes.

- Check for cracking, chipping, or peeling of the electrode insulation.
- Check for cuts or cracks in the cable insulation and handles.
- Inspect the cable connector casing for cracks or distortion. Inspect for bent or corroded connector pins.
- The internal paddle adapter, which interfaces the internal paddle cable with the PIC, is not intended to be sterilized. If this type of damage is observed, PIC operators must be notified that the internal paddle adapter is not intended to be sterilized.
- Replace damaged items prior to returning the PIC to normal use.

5. Inspect cables

- Inspect all patient cables for signs of wear or damage that can result from frequent use.
- Check for cracks or cuts in the cable insulation and strain reliefs. Inspect for bent or corroded pins.
- Inspect each patient cable snap connector because these can be susceptible to corrosion from electrode gel and other fluids that may accidentally contaminate the snaps.
- Remove any damaged cables from service and replace them prior to returning the PIC to normal use.

6. Inspect AC power cord

- Inspect the mains (line) power cord for damage that can occur if the power cord is disconnected frequently or subject to abuse when pulled from a receptacle.
- Check the cord for cuts or cracks in the insulation and strain reliefs.
- Inspect the connector pins for bending that could indicate abuse.
- Replace a damaged power cord prior to returning the PIC to normal use.

Recommended Test Equipment

The following test equipment is commercially available from many manufacturers. Some models combine the features of more than one required instrument into a single analyzer. For example, the Impulse 4000 from DNI Nevada, Inc. can be used to perform all of the recommended tests on a MRL Lite, except electrical leakage.

Any equipment used must be calibrated and specified to perform within the following minimum requirements.

1. ECG Simulator

- Normal sinus rhythm with selectable rates from 30 to 300 bpm and amplitudes from 0.5 to 2.0 mV.
- Sine wave with selectable frequencies from 0.05 Hz to at least 100 Hz.
- Selectable arrhythmias including ventricular fibrillation.
- 12-lead ECG simulation is needed for a PIC equipped with the 12-lead option (971026 and 971027).

2. Defibrillator Tester

- Capable of accurately measuring PIC defibrillator outputs which are trapezoidal (truncated exponential) in shape.
- Energy measurement from 1 to 360 J.
- Standard 50Ω non-inductive test load.

3. Pacer Tester

- The ability to connect to the PIC hands-free cable, usually with an appropriate adapter that will also select the correct test load and measurement technique.
- Peak current measurement from 5 to 180 mA.
- Rate measurement from 30 to 200 bpm.
- A test load in the range of 500 to 700Ω.
- Capable of measuring a 20 ms pulse width.

4. Stop Watch or Clock

- When timing defibrillator charge time, resolution to the nearest second is required.
- When timing battery charge time, the ability to measure a total elapsed time of approximately 4 hours is required.

5. Electrical Safety Analyzer

- Automatic or manual selection of the correction mains (line) voltage.
- Standard test load compliant with either AAMI ES1 or EN60601-1.
- Measurement of leakage current from 1 to 300 µA.
- Measurement of ground resistance in the range of 0.1 to 0.2Ω.
- Isolation test voltage that is typically 110% of the selected mains voltage.

6. Non-Invasive Blood Pressure Analyzer

- Oscillometric simulation method with Luer-type cuff adapter.
- Static pressure measurement from 0 to 300 mmHg.
- Repeatable programmed target values for systolic, diastolic, MAP, and heart rate.

7. Pulse Oximeter Tester

- Integral test finger to interface with the PIC oximeter probe.
- Automatic or manual selection of calibration curve for the PIC.
- Selectable oxygen saturation levels from 70 to 99%.
- Selectable heart rate from 20 to 250 bpm.

8. IBP Transducer Simulator

- FOGG System Company, Inc., Denver, CO, Model BP-28.

9. CO_2 Sensor and Adapter

Safety Testing

Equipment Required

Electrical Safety Analyzer

The tests recommended for routine safety checks can be readily performed with any of a number of commercially available safety analyzers. This equipment provides a reasonably safe and convenient method of verifying the degree of protection against electric shock employed by the PIC. Typically, the analyzers can perform the following tests.

Caution: To prevent possible equipment damage, do NOT attempt to discharge a defibrillator into the safety analyzer.

- **Ground resistance** - power cord only, because no exposed parts of the PIC are connected to protective earth.
- **Earth leakage** - the leakage current in the protective earth (ground) wire.
- **Enclosure leakage** - between exposed, conductive chassis points and protective ground.
- **Patient source leakage** - between patient leads and protective grounds or between any two patient leads.
- **Patient sink leakage** - Mains (line) voltage applied to patient leads.

The tests should be performed according to the operating instructions pertaining to the safety analyzer in use. Electrical safety checks can be performed at intervals established by user preference. The maximum length of time between checks should not exceed one year. The checks must be performed following any repair of the PIC.

Acceptable Results

- Ground resistance must not exceed 0.1Ω.
- Earth leakage current must not exceed 500 µA, NC (normal condition) or 1000 µA, SFC (single fault condition).
- Enclosure leakage current must not exceed 100 µA, NC or 500 µA, SFC.
- Patient source leakage, for any patient lead except paddles or pads, must not exceed 10 µA, NC or 50 µA, SFC.
- Patient source leakage, for paddles or pads, must not exceed 100 µA, NC or 500 µA, SFC.
- Patient sink leakage, for any patient lead except paddles or pads, must not exceed 50 µA, SFC.
- Patient sink leakage, for paddles or pads, must not exceed 5000 µA, SFC

Corrective Action

Remove the unit from service until any unacceptable result is rectified. Possible causes of excessive leakage currents are usually related to damage insulation or mis-wiring during equipment repair. Excessive ground resistance indicates a need to replace the AC power cord.

ECG Monitor

Frequency Response (Diagnostic Bandwidth)

Equipment Required

ECG simulator with 1 mV sine wave, selectable in frequency from 0.05 to 100 Hz

Procedure

1. Connect the ECG simulator to the PATIENT input on the monitor.
2. Set the ECG simulator for 0.05 Hz sinusoidal output at 1 mV peak-to-peak.
3. Turn on monitor and set Lead Selector switch to Lead II.
4. Set the size control to 1 cm/mv. Set the frequency response of the PIC to Diagnostic.
5. Start the chart recorder and record several cycles of the test signal.
6. Repeat steps 1 through 5 with the simulator frequency set to 100 Hz.

Acceptable Results

The amplitude of the recorded test signals in steps 5 and 6 must be 7 ±0.5 mm.

NOTE: This measurement is made from peak-to-peak, which are spaced 10 cm apart for the 0.05 Hz test signal.

Corrective Action

- If measured bandwidth is unacceptable, verify that the simulator output is constant over the frequency range. Frequency response is determined by fixed component values (not adjustable in the monitor).
- Replace the ECG preamp board (Item 51) if not within specifications.
- Refer to Chapter 7, *Troubleshooting Guide* for additional information.

Sweep Speed and Paper Speed Accuracy

Equipment Required

ECG simulator with calibrated output rates

Procedure

1. Connect ECG simulator to PATIENT input of monitor. Set rate to 60 bpm and amplitude to 1 mV.
2. Press Power switch to on.
3. Set Lead Selector switch for Lead II.
4. Set Size control to 1 cm/mV.
5. Measure distance between R-wave peaks on the monitor and on the recorder chart.

Acceptable Results

Distance between R-wave peaks should be 25 ±2.5 millimeters on both the monitor and recorder.

Corrective Action

- Verify accurate simulator rate.
- Replace Chart Recorder (Item 36) if chart speed is not within specification.

ECG Amplitude Calibration

Equipment Required

ECG simulator with calibrated 1-millivolt amplitude output

Procedure

1. Connect ECG simulator to PATIENT input on monitor.
2. Set simulator for 1-millivolt output at 60 bpm.
3. Turn on monitor and set Lead Selector for Lead II.
4. Set the size control on the monitor for 1 cm/mv. Set the frequency response of the PIC to Diagnostic.
5. During interval between beats, depress 1-millivolt calibration control to generate a calibration pulse on the monitor.
6. Repeat steps 2 and 3 to test chart recorder amplitude calibration.

Acceptable Results

Amplitude on display and chart recorder should be 1 cm ±1 mm.

Corrective Action

- Verify simulator amplitude accuracy (many simulators deliver calibrated output only in certain lead positions).
- Verify proper setting of Size control for 1 cm/mV ECG amplitude. If amplitude is still out of range, adjust R46 on the 5-lead ECG preamp board (Item 51). ECG amplitude cannot be adjusted on a 12-lead ECG preamp board.

Heart Rate Display Accuracy

Equipment Required

ECG simulator with calibrated adjustable output rate

Procedure

1. Connect simulator to the PATIENT input on the monitor.
2. Set simulator output for 1 millivolt. Select a rate which falls within range of 20 to 300 bpm.
3. Turn on monitor. Set Lead Selector switch to Lead II. Set Size control for 1 cm/mv amplitude on monitor.
4. Allow rate meter to stabilize approximately 30 seconds then note the reading. Run the chart recorder to obtain a printed heart rate.
5. Select several other rates within 20 to 300 bpm range. Allow rate meter to stabilize 30 seconds after each rate change, then note the reading.

Acceptable Results

For each heart rate checked, heart rate must not differ by more than 5% from actual rate.

Corrective Action

Verify simulator rate setting accuracy.

If heart rate is still out of range, refer to the “Artifact on ECT” listing in Chapter 7, *Troubleshooting Guide*.

Defibrillator

CAUTION! Lethal voltages can be present inside the defibrillator and at the defibrillator electrodes. Use extreme caution when the defibrillator is charged or the case is open.

Defibrillator Energy Accuracy

Equipment Required

Defibrillator analyzer capable of measuring trapezoidal wave form output (MRL DT2000A or equivalent)

Procedure

1. Press Power switch to ON.
2. Select Energy level and charge defibrillator.
3. Discharge into the analyzer.

Acceptable Results

The maximum acceptable error is ±10% or within 2 J, which ever is greater.

Corrective Action

- If energy measurements are not within tolerance, verify that the analyzer is accurate when measuring a trapezoidal output.
- If the analyzer is correct, then refer to the “Delivers incorrect energy” listing in Chapter 7, *Troubleshooting Guide*.

Defibrillator Charge Time

Equipment Required Stopwatch

Procedure

1. Test only fully charged battery packs.
2. Operate the defibrillator on battery power at a setting of 360 joules.
3. Charge the defibrillator and then discharge it into the test load of the battery charger. Repeat this process 10 times, allowing approximately 1 minute between each test shock.
4. Measure the charge time for the 10th shock. This time should be less than 7 seconds for the SmartPak Plus battery or less than 9 seconds for the SuperPac battery.

NOTE: Perform this test at the rate of two quick discharges followed by a 30-second rest period.

Acceptable Results The charge time should be approximately <7 seconds for the SmartPak Plus battery or <9seconds for the SuperPac battery.

NOTE: Results may vary somewhat due to the reaction time involved in stopwatch operation.

Corrective Action

- Verify that the battery has been fully charged.
- If the battery is fully charged, see the “Failure to charge” listing in Chapter 7, *Troubleshooting Guide*.
- If the charge time exceeds the limits given in step 4, recondition the battery pack and perform the test again. If the battery pack fails the test, consider the age of the battery and the frequency of use. These factors determine how long a battery can continue to provide adequate performance. A weak battery should be removed from service and replaced with a new, fully charged battery.

Synchronized Discharge

Equipment Required Defibrillator analyzer with cardioversion delay measurement

Acceptable Results The time delay between the start of the leading edge of the simulator pulse (oscilloscope trigger) and the leading edge of the defibrillator discharges should be 60 milliseconds or less.

Corrective Action

- Confirm proper synchronization by observing a blinking Sync LED.
- Sync delay time is determined by fixed values (not adjustable) in the unit. Refer to the “Failure to fire in sync mode” listing in Chapter 7, *Troubleshooting Guide*.

Transthoracic Pacemaker (if equipped)

CAUTION: High voltages can be present inside the pacer and at the pacer output.

Transcutaneous Pacemaker (preferred test method)

Equipment Required

Transcutaneous pacemaker analyzer with any adapter required for connection to the PIC

Procedure

1. Connect the hands-free defibrillator of the PIC to the correct blue and white mating connector as supplied with the transcutaneous pacemaker analyzer.
2. Operate the analyzer according to the instructions provided with it.
3. Turn on the PIC pacer. Set the MODE to ASYNC. Set the RATE to 180 bpm and the OUTPUT to 180 mA. Press the START button to initiate pacing into the analyzer.
4. Measure rate, output current, and pulse width on the analyzer.
5. RATE and OUTPUT settings can be checked in this manner.
6. Set the MODE to DEMAND. Follow the instructions for the analyzer in use to verify that a pacer output occurs only when called for—when the simulated heart rate drops below the RATE setting of the Pacer.

Acceptable Results

Rate: 333 msec ±5%

Current: voltage across a 700µ load should be 126V ±10%

Pulse width: 20 msec ±5% at the 50% point of the waveform

Advisory Option (if equipped)

Equipment Required

Cardiac Demonstrator (015-0622-00) or ECG simulator with Arrhythmias including ventricular fibrillation

Procedure

1. Connect the patient cable to the Cardiac Demonstrator and to the PIC.
2. Set the Cardiac Demonstrator to VFIB and turn the power ON.
3. Press the A button on the PIC. The PIC should display a SHOCK ADVISED message within 12 to 16 seconds.
4. Set the Cardiac Demonstrator to NSR 120.
5. Press the A button. The PIC should display a NO SHOCK ADVISED message within 4 to 16 seconds.
6. Repeat steps 4 and 5 with the Cardiac Demonstrator set to Asystole and verify a NO SHOCK ADVISED result.

Acceptable Results

See steps 3 and 5.

Corrective Action

Refer to the “Artifact on ECG” listing in Chapter 7, *Troubleshooting Guide*.

Battery Charger Test Procedure

Use this procedure to test either type of charger option: the attached Paddle Tray/Power Supply or the separate Quick Charger.

Equipment Required

Stopwatch or clock to measure elapsed time. Defibrillator and a battery that has successfully passed the capacity test, but has not yet been recharged.

Procedure

1. Connect AC power and verify that the green POWER indicator is on. If the separate Quick Charger is being tested, connect its Auxiliary Power cable to provide power to the PIC. Do not insert a battery into the PIC.
2. Press Power Switch to on. Set the ENERGY SELECT control to 360 J. Use a stopwatch or the second hand on a clock to measure the approximate time required to charge the defibrillator to full energy.
3. Reduce the energy setting to 200 J. Use a defibrillator tester to verify that the actual output is within 10% ±20 J. Also verify that the 150 J output is within 10%. If this required accuracy cannot be confirmed, refer to the procedure for testing defibrillator energy accuracy.
4. When defibrillator outputs are confirmed to be correct, test the integral DEFIB TEST function by discharging into the test load located in the paddle tray (AC Supply/Paddle Tray Option) or on either side of the Quick Charger. First, charge the defibrillator to 1 5 0J and discharge it into the test load while observing that the DEFIB TEST indicator does not blink. Then, repeat the test at 200 J while observing that the DEFIB test indicator blinks.
5. Turn off the PIC but keep the AC power connected. Insert a depleted battery into the charger (or directly into the PIC if testing the AC Supply/Paddle Tray). The charger should come on continuously and stay on as along as the battery is charging. Note the starting time for the battery charging period.
6. Allow a period of time for the battery to fully charge. This period will depend on the type of battery being tested. Refer to the following chart to determine typical charge time for the different battery types available. The times given are for charging at normal room temperature. They will decrease under cooler conditions and increase under warmer conditions.

Battery Charge Times

Battery Type	Typical Recharge Time (25°C)
SuperPac	9 to 10 hours
SmartPak Plus	4 to 5 hours
SmartPak	3.5 to 4 hours

Acceptable Results

- Defibrillator charge time will typically be 10 to 12 seconds with AC power only. The maximum acceptable time is 15 seconds.
- The DEFIB TEST indicator must flash with a 200 J output, but not at 150 J.
- The charge indicator should begin to blink when the battery under test is fully charged.

Corrective Action

- Verify that the AC power cord is securely connected to a properly wired power source (100 to 240 VAC). While the AC Supply/Paddle Tray option requires no voltage switching, the Quick Charger must be set to match the available AC voltage. This is accomplished by removing and repositioning the selector insert that is a part of the AC inlet on the rear panel of the charger.
- It is normal for the DEFIB TEST indicator to flash only dimly at 200 J. However, it should be noticeably brighter at higher levels of output energy.
- Verify that the battery is fully seated to ensure proper battery charging. Be sure that the battery under test matches the type selected from the above chart.
-

3-Volt Lithium Battery Check

It is recommended that the 3-V lithium battery (Item 56) be replaced every 5 years. If the PIC prints a “Setup Defaults Restored” message or loses the time/date setting, the battery may have to be replaced sooner. The battery should measure >2.75V. If the battery voltage is low, replace the 3-V lithium battery.

Battery Capacity Test and Reconditioning Procedure

Due to the critical nature of this equipment, it is important to test PIC batteries at least every 90days to verify adequate available battery capacity. The test should be performed every 30 days if batteries are charged in a high temperature environment (above 30°C, 80°F) or if they are heavily used (charged and discharged more than once a day). Because this test completely drains the battery, it also serves an important reconditioning cycle that will help ensure maximum capacity.

Equipment Required

- Stopwatch or clock to measure elapsed time
- PIC with only the ECG monitor function activated

NOTE: Battery run time is different for the various PIC options available. Refer to the following comparison chart to determine typical operating time for specific PIC options and battery types.

Battery Capacity Comparison

Select Options Below to Determine Minimum Battery Run Time	Part Number	Minimum ECG Monitoring Time (Hours)		
		SmartPak	SmartPak+	SuperPac
MRL Lite	971039	2	2.5	5
PIC with 5-Lead ECG & Mono LCD Display	971042 971044	2	2.5	5
PIC with 5-Lead ECG & EL Display	971009	1.5	2	4
PIC with 5-Lead ECG & Color LCD Display	971013	1.25	1.5	3
PIC with 12-Lead ECG & EL Display	971026	1.25	1.5	3
PIC with 12-Lead ECG & Color LCD Display	971027	1	1.25	2.5

Procedure

1. Completely charge the battery to be tested. The charger indicator begins to blink when the battery is fully charged.
2. Disconnect the PIC from AC power so that it is powered only from the battery to be tested.
3. Turn on the PIC monitor and note the starting time.
4. Verify continued operation at intervals of 30 minutes or less.

5. When the battery power runs out, note the time. This gives the duration of time that relates directly to battery capacity. Compare this run time to the value, given in the comparison chart above, that corresponds to the PIC and battery type being use.

Acceptable Results

- Battery run time must meet or exceed the minimum time given in the comparison chart.
- Recharge batteries fully prior to placing them back into service.

Corrective Action

- If the actual battery run time is less than the value given in the chart, repeat the test to determine if reconditioning was effective in improving available capacity. If the operating time remains short, remove the battery from service and replace it.
- If battery run time is short, be sure that the correct PIC and battery type have been selected on the comparison chart.
- Verify that the battery is fully charged prior to the capacity test.
- Consider the age of the battery and the frequency of its use. The recommended replacement interval in this critical application is every 2 years as indicated on the battery label.

Guidelines for Maintaining Peak Battery Performance

1. Each battery should be identified with a number or letter. An identification mark will be useful in tracking battery performance.
2. Keep extra batteries in the MRL charger where their status can be quickly determined. A blinking indicator is the most positive indication of a fully charged battery.
3. Always carry at least one fully charged spare battery. If no other source of back-up power is available, two spare batteries are advisable.
4. Rotate spare batteries routinely. The charge level gradually diminishes in a battery after it is removed from the charger.
5. Whenever possible, recharge a partially depleted battery. This can be accomplished following any incident that involves patient monitoring. It will ensure maximum operating time for each use, without reliance on spares. The need for a spare can then serve as an alert when an aging battery fails to provide normal operating time.

12-Lead ECG Data Acquisition and Fax Modem Test

Perform this test only if the PIC to be tested is equipped with the 12-Lead ECG option (971026 and 971027). If the PIC also has the fax modem option (971019), test the fax modem function.

NOTE: Fax transmission requires the use of an approved telephone link. Do not alter telephone numbers and other information programmed by the equipment user during this procedure. Either obtain permission to use a programmed fax number or enter any other authorized number in an unused User Dial menu location.

Equipment Required

12-Lead ECG Simulator

Procedure

1. Connect the PIC 12-Lead ECG cable to the ECG simulator. Adjust the simulator, according to its operating instructions, to generate a 12-lead test signal. Set the rate and amplitude to any typical value, such as 1 mV and 60 bpm.
2. Turn on the PIC and use the LEAD SELECT control to verify ECG pickup on all 12 lead settings.
3. Refer to the operating instructions for detailed information on 12-lead Quick Access menu selections. Use the Patient ID menu selections to label the activity as a test. Use the ACQUIRE command to obtain a 12-lead snapshot.
4. Select the Printer icon to document test results. If the equipment under test has a fax modem, it can be checked by selecting the telephone icon. As indicated above, use of this option required an approved telephone link and authorized fax number.

Acceptable Results

- The ECG waveforms obtained for each lead setting should agree with those specified for the simulator in use.
- Acquired ECG samples must be formatted to clearly display all 12-lead segments and identifying information.
- The fax modem, if available for test, must successfully transmit the acquired ECG. All 12-lead segments and identifying information should be correct and legibly formatted for 8x11” paper size.

Corrective Action

- Verify that the ECG simulator generates accurate 12-lead test signals.
- Check the patient cable if a Lead Fault message appears on some but not all lead settings.
- Fax modem parameters may not be compatible with the test link. Verify the settings in the Fax Settings Supervisory menu. Be certain the settings will be correct under conditions of actual equipment use.

Non-Invasive Blood Pressure Performance Test

Equipment Required NIBP Analyzer

Procedure

1. Connect the PIC BP hose/cuff assembly to the NIBP analyzer using its appropriate Luer-type cuff adapter.
2. Select BP CAL as described in the operating instructions under Supervisor Menus-Setup.
3. Use the Pump Up and Pump Down commands to manually adjust the PIC BP cuff. In this mode, static pressure is shown on the PIC display in the lower right corner of the BP window. Allow a few seconds after changing the pressure for the reading to stabilize. If a stable reading is not obtained, perform the analyzer's Leak Rate Test.
4. Check the accuracy of the PIC static pressure readings at 200, 140, and 50 mmHg by comparing them to the corresponding readings on the NIBP analyzer.
5. Perform the analyzer's Overpressure Test to confirm that this safety feature actuates properly.
6. Return to the normal user menu. Set the NIBP analyzer to simulate a typical BP reading, such as 120/80 at a heart rate of 80 bpm.
7. Test the PIC BP cycle according to the instructions for the analyzer in use. Compare the readings obtained by the PIC to the parameter settings of the NIBP analyzer.

Acceptable Results

- Static pressure readings obtained in the BP CAL mode must agree with the analyzer readings within 2 mmHg.
- The rate of pressure loss (leak rate) must not exceed 6 mmHg/minute.
- The overpressure activation must occur at 300 ±15 mmHg. It must result in release of pressure and reset of BP operation.
- The BP readings, determined by the PIC, must agree with the parameter settings of the NIBP analyzer within 5 mmHg. The heart rate indication must agree within 4 bpm.

Corrective Action

- Internal calibration adjustments are provided for the static pressure reading. These adjustments should be made only by a qualified technician using a calibrated instrument (NIBP analyzer) of known accuracy.

- To access the adjustments, follow the disassembly procedures to remove the BP assembly from the card cage assembly. Set the assembly on insulating material, close enough to the Motherboard to reconnect the flat cable that links the two together.
- Adjustments must be made while in the BP CAL mode of the Setup/Supervisor Menu. The first adjustment is made to R48 while no cuff pressure is present (disconnect BP hose from the PIC). Set R48 so that the pressure display in the lower right corner of the BP window reads 0. Connect the PIC BP hose to a calibrated pressure gauge (NIBP analyzer). Use the Pump Up and Pump Down commands to set the pressure. When the pressure stabilizes, compare the reading on the PIC pressure display with that of the calibrated analyzer. Check the accuracy at pressure settings of 200, 140, and 50 mmHg. Adjust R47 so that all 3 pressure readings agree with the analyzer within 1 mmHg.
- Excessive leak rate is usually caused by either the external hose or cuff. If the air leak is internal, check for hose connections that may have been disturbed during any prior service procedure. Refer to the troubleshooting guide for other possible causes.
- If overpressure sensing is not within acceptable limits, replace the overpressure switch. Refer to the disassembly procedures for the Blood Pressure Pump/Valve Assembly (Item 69).

Pulse Oximeter Performance Test

Use this procedure to verify proper performance of the PIC SpO_2 option at normal intervals or whenever the SpO_2 probe is replaced.

Equipment Required

Pulse Oximeter Tester with the correct calibration curve for the MRL model PIC, if the tester in use requires these custom curves

Procedure

1. Attach the PIC oximeter probe to the test finger on the oximeter tester and operate the tester according to the instructions for the particular tester in use.
2. To ensure that the PIC is using the oximeter signal to determine its displayed heart rate, disconnect or disable other signal inputs from which the heart rate could be derived (ECG or BP).
3. Set the simulated oxygen saturation level on the oximeter tester to an available setting closest to 70%. Set the tester's simulated heart rate to any available setting within a range of typical values between 60 and 120 bpm.
4. With the PIC SpO_2 function set to ON, verify that a Signal OK message is displayed in the SpO_2 window. Allow the PIC SpO_2 and HR readings to stabilize and compare them to the settings of the tester.
5. Repeat step 4 at available settings of the tester that are closest to 80%, 90%, and 99%.

Acceptable Results

- The accuracy of PIC SpO_2 readings must be within 3% for oxygen saturation levels from 70 to 80%.
- The accuracy of PIC SpO_2 readings must be within 2% for oxygen saturation levels from 81 to 99%.
- Heart rate accuracy should be within 5%.

Corrective Action

- If the particular oximeter tester in use requires manual selection of a calibration curve, verify that a curve specifically suited to the PIC has been selected.
- Check for proper fit and alignment of the PIC oximeter probe on the test finger.
- Consider the specified accuracy of the tester in use. The PIC provides a means of adjusting the SpO_2 reading to compensate for minor variations that are within the typical range of tester accuracy. To access this adjust, enter the Supervisor/Dig/SpO_2 menu. Use the up/down commands to change the SpO_2 reading by a constant value ranging from -2 to +2.

IBP Performance Test

Equipment Required IBP Transducer Simulator

Procedure

1. Connect the transducer simulator to the IBP1 input. Zero the PIC IBP reading with the simulator set to -100mmHG. Set the polarity switch of the simulator to the “zero” position. Verify that the IBP reading is 100+/-2mmHg.
2. Change the transducer simulator setting to +100mmHg. Zero the PIC IBP reading. Raise the simulator setting to 200mmHg. Verify that the IBP reading is 100+/-2mmHg.
3. Zero the PIC IBP reading with the transducer simulator set to the zero position. Change the simulator to a setting of 20mmHg. Verify that the IBP reading is 20+/-2mmHg.
4. Change the transducer simulator setting to 200mmHg. Verify that the IBP reading is 200+/-2mmHg.
5. Change the transducer simulator setting to -200mmHg. Verify that the IBP reading is -200+/-2mmHg.

Acceptable Results

- IBP readings on the display must not differ from those specified in the above procedure.

Corrective Action

- Verify the accuracy of the IBP transducer simulator setting.
- If the IBP readings are still not within tolerance, check the BP Board (Item 92).

CO_2 Performance Test

Equipment Required CO_2 Sensor and Adapter

Procedure

1. Turn unit on and turn CO_2 on by toggling the CO_2 button on the Quick Access menu.
2. Connect the CO_2 probe to the CO_2 input.
3. Breathe into the CO_2 sensor at a normal rate.

Acceptable Results

- Display should show CO_2 trace and numerical reading. Typical numerical readings are 36-38mmHg.

Corrective Action

- Verify CO_2 is on and correct display settings.
- If CO_2 trace or readings do not display, check the CO_2/Ox Main cable (Item 91), CO_2/Ox board (Item 103).

CHAPTER 6: THEORY OF OPERATION

This chapter presents the theory of operation for the MRL PIC system. The system is described in terms of its main assemblies.

Chapter Overview:

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- *Power Distribution 6.2*
- *Motherboard. 6.3*
- *5-Lead ECG Monitor 6.4*
- *Displays 6.5*
- *Chart Recorder 6.6*
- *Front Switch Panel. 6.6*
- *Voice Memo and Voice Prompts 6.7*
- *1-Volt Output 6.7*
- *PCMCIA Interface 6.7*
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- *Oximeters. 6.8*
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- *Interconnect Diagram. 6.13*

Overview

An Interconnect Diagram is included at the end of this chapter. Use the diagram as a reference when reviewing the theory of operation information presented in this chapter.

- Refer to the part/item number table (Sheet 1) in Chapter 9 to identify the parts described in the theory of operation.
- Refer to the assembly drawings in Chapter 9 (Sheets 2-9) for information on the placement and configuration of the items.

Power Distribution

Power Supply

The PIC can be powered from AC power or a battery.

The AC power cable is connected to the receptacle in the back of the optional AC Supply/Paddle Tray Module (Item 17). The AC Supply/ Paddle Tray Module contains a 12VDC power supply, battery charger, and defibrillator tester. The PIC can also be powered from the quick charger AUX power cable. The 12VDC and the charger current are routed to the PIC electronics through a cable that connects to the Battery Board (Item 54) via a connector in the top of the PIC. The Battery Board contains EMI suppression circuitry and terminals for the removable battery. There are two sets of redundant contact terminals for the battery. The power from both the battery and the AC supply are routed to J2 on the Power Supply Board (Item 44) via a cable that passes through the chassis.

The power supply is turned on by switching the Power Switch (Item 58) on the front of the PIC. The power switch is connected to J6 of the Power Supply Board (Item 44) by a 5-wire cable.

When the AC power cable is connected and plugged into a live wall outlet, the PIC draws power from the AC supply and the battery is charged by the charger. The green AC Power indicator and the yellow Battery (Batt) Charger indicator on the AC Supply/Paddle Tray (Item 17) are illuminated. If the battery is fully charged, the Battery Charger indicator flashes and the AUX indicator appears on the display instead of the battery gauge. If the AC mains voltage or AC supply output drops below a level required to supply sufficient current to the PIC, the Power Supply Board (Item 44) automatically switches on the battery to boost the voltage. In this case, the battery gauge appears on the display even though the AC power is connected. The gauge indicates that the battery is being discharged.

The Power Supply Board (Item 44) contains switching circuits to generate power of ±5VDC and +11VDC. These power signals are routed through J1 of the Power Supply Board to J4 of the Motherboard (Item 46) where they are distributed to the remaining modules. An additional cable carries +11VDC from J4 of the Power Supply Board to the Display Adapter Board (Item 49, 85, or 89).

The unregulated voltage from the battery (9.8 to 13.5 VDC) or AC supply charges the defibrillator and powers the chart recorder thermal array. The power signal is routed to the Defibrillator Module (Item 23) through a 2-wire cable connected to J7 of the Power Supply Board (Item 44). The power signal is also routed to the Chart Recorder (Item 36) through the Motherboard (Item 46) via a 2-wire

cable connected to J5 on the Power Supply Board. The power supply is fused with a 1.5A surface-mount fuse on the Motherboard.

The unregulated voltage is monitored while running on battery power. If the battery voltage dips below 11.7VDC for a 20-second period, a Low Battery condition will be indicated. When the voltage dips below 9.8VDC, the power supply will shut down the unit.

A 3-V Coin-Cell Battery (Item 56) on the Power Supply Board powers the clock and maintains the battery backed-up, static RAM on the Motherboard (Item 46). The static RAM contains configuration parameters and Treatment Log data. If the 3V Coin-Cell Battery (Item 56) is discharged or if the Power Supply Board (Item 44) is disconnected from the Motherboard (Item 46), the data in the static RAM will be lost and the default configuration parameters will be restored.

Motherboard

The main microprocessor that controls the display, chart recorder, and front switch panel, and communicates with the other modules, resides on the Motherboard (Item 46). The Motherboard also contains the time-date clock and the battery backed-up static RAM. The static RAM contains configuration parameters and Treatment Log data. The processor on the Motherboard monitors the battery condition and the power source and indicates the power status by displaying a battery gauge, a low battery icon, or an AUX power indicator in the display area. The Motherboard maintains product serial number data and purchased options in non-volatile flash memory.

The Motherboard (Item 46) communicates user input to the Defibrillator Module (Item 23) or Pacer via a serial bus through a 16-pin FCC Defib Main Cable (Item 19) connected to J218 of the Motherboard and J8 of the Defibrillator Module. The +5VDC used to power the Defibrillator Module microprocessor and the QRS sync pulse from the 5-Lead or 12-Lead ECG Preamp Board (Item 51 or 84) are also routed through the 16-pin FFC Defib Main Cable (Item 19). A Pacer blanking signal is sent to the ECG Preamp Board from the Defibrillator Module via the Defib Main Cable (Item 19) when the Pacer is pacing.

The Motherboard (Item 46) communicates user input to the ECG Preamp Board (Item 51) via an opto-isolated serial bus through the 5-Lead or 12-Lead Preamp Motherboard Cable (Ite m52 or 82) connected to J217 or J104 of the Motherboard and J2 of the ECG

Preamp Board. The QRS sync and pacer blanking signals are also routed through Defib Main Cable (Item 19). The +5VDC is routed to the ECG Preamp Board to power the optocouplers and digital buffers. The rest of the ECG Preamp Board is powered through an isolated supply by the 11VDC supply.

5-Lead ECG Monitor

5-Lead ECG signals can be monitored from either the patient cable or the paddle set. ECG signals from the patient cable pass through the Patient Input Connector Board (Item 40) to J1 of the Paddle Preamp Board (Item 27) and on to the ECG Preamp Board (Item 51) via a Preamp Protection cable (Item 32). The cable is connected from J3 of the ECG Preamp Board to J2 of the Paddle Preamp Board, and is sheathed with an insulating shrink-tube barrier to isolate the patient-connected signals from grounded circuitry. ECG signals from the paddle set pass from the Defibrillator Module (Item 23) to J3 of the Paddle Preamp Board (Item 27) through a gain stage and an analog optocoupler before being routed through the Preamp Protection Cable (Item 32) to the ECG Preamp Board.

The Patient Input Connector Board (Item 40) contains EMI and defibrillator protection circuitry and the AAMI standard 6-pin connector. The Paddle Preamp Board (Item 27) contains the paddle pickup preamplifier, protection circuitry, and the impedence transformers for detecting paddle set and pacer-pad lead faults.

The ECG Preamp Board (Item 51) contains ECG gain and filtering circuitry, QRS detection circuitry, lead fault detection circuits, and pace detection/blanking circuits. A microprocessor on the ECG Preamp Board samples and digitizes the ECG and sends the data to the Motherboard (Item 46) via an opto-isolated serial bus. Communication to the Motherboard (Item 46) passes through a 22-pin FCC Preamp-Motherboard Cable (Item 52) connected to J217 of the Motherboard and J2 of the ECG Preamp Board. In addition, the QRS sync pulse to the Defibrillator Module (Item 23) and the pace blanking signal from the defibrillator pass through the Defib Main Cable (Item 19) to the Motherboard (Item 46). The optocouplers and digital buffers on the ECG Preamp Board are powered by +5VDC. The rest of the ECG Preamp Board (Item 51) is powered through an isolated supply by the 11VDC supply. The 11VDC supply is fused on the ECG Preamp Board.

Displays

The LCD, EL, and TFT (Color) Displays are controlled by the main processor and a display co-processor on the Motherboard (Item 46).

LCD Display

Display control signals and the +5VDC power signals are routed to the LCD Display Adapter Board (Item 49) through the Flat Panel Display Cable (Item 50). The cable is a 30-pin FFC cable, and connects to J220 of the Motherboard (Item 46) and J1 of the LCD Display Adapter Board (Item 49). The 11VDC power signal is routed from J4 of the Power Supply Board (Ite m44) through a 2-pin cable attached to the LCD Adapter Board. Signals to the LCD Display continue through the LCD Adapter Board from J5 through a Mono LCD Cable (Item 35), which is connected to the LCD Display mounted in the Top Enclosure Assembly (Item 22).

The LCD Display Adapter Board (Item 49) contains a digital potentiometer for brightness and contrast adjustment, switching circuits to enable the backlight and display power supplies, and an adjustable LCD bias voltage power supply. The 11VDC signal is switched by a transistor and then routed to the Backlight Inverter (Item 43) through the LCD Inverter Cable (Item 34), a 5-pin cable connected to J4 of the LCD Display Adapter Board, and CN1 of the Backlight Inverter.

EL Display

Display control signals and the +5VDC power signals are routed to the EL Display Adapter Board (Item 89) through the Flat Panel Display cable (Item 50). The cable, a 30-pin FFC cable, connects to J220 of the Motherboard (Item 46) and J1 of the EL Display Adapter Board (Item 89). The 11VDC power signal is routed from J4 of the Power Supply Board (Item 44) through a 2-pin cable attached to the EL Display Adapter Board (Item 89). Signals to the EL Display continue through the EL Adapter Board from J2 through the EL Display Cable (Item 71), which is connected to the EL Display mounted in the Top Enclosure Assembly (Item 22).

The EL Display Adapter Board (Item 89) contains switching circuits to enable the display power supplies.

TFT (Color) Display

Display control signals and the +5VDC power signals are routed to the Color Display Adapter Board (Item 85) through the Flat Panel Display Cable (Item 50). The cable is a 30-pin FFC cable and connects to J220 of the Motherboard (Item 46) and J4 of the Color Display Adapter Board (Item 85). The 11VDC power signal is routed from J4 of the Power Supply Board (Item 44) through a 2-pin cable attached to the Color Display Adapter Board (Item 85). Signals to the Color Display continue through the Color Display Adapter Board (Item 85) from J3 through the Color Display Cable (Item 108), which connects to the Color Display mounted in the Top Enclosure Assembly (Item 22).

The Color Display Adapter Board (Item 85) contains a digital potentiometer for brightness adjustment, switching circuits to enable the backlight, and display power supplies. The 11VDC signal is switched by a transistor and then routed to the Dual Backlight Inverter (Item 96) through the Color Inverter Cable (Item 109), a 7-pin cable connected to J2 of the Color Display Adapter Board (Item 85) and CN1 of the Backlight Inverter (Item 96).

Chart Recorder

The Chart Recorder (Item 36) is controlled by the main processor on the Motherboard (Item 46). Control signals, the +5VDC, and the fused, unregulated, battery voltage are routed to the chart recorder from J114 of the Motherboard through the Chart Recorder Cable (Item 53). The Chart Recorder Cable is mounted to the Top Enclosure Assembly (Item 22) by screws.

Front Switch Panel

The Front Switch Panel is controlled by the main processor on the Motherboard (Item 46). Signals to the Front Switch Panel are routed through the Front Panel Cable (Item 31), a 12-pin FFC cable connected to J108 on the Motherboard. The Pacer controls and the Sync and Pacer LEDs are controlled through the Pacer Panel Cable (Item 30), a 14-pin FFC cable, connected to J211 on the Motherboard. The switches are arranged in a row-column configuration. Pressing a switch shorts a row and column together. The main processor checks the Front Switch Panel for stuck keys at power-up.

Voice Memo and Voice Prompts

Voice Memo and Voice Prompts are controlled by the main processor on the Motherboard (Item 46). Control signals and the 5VDC power signals are routed to the Speech Board (Item 94) at J210. Pressing the Voice Memo button on the front panel initiates a sequence that digitally records sound. The recordings are stored in the internal log or on a PCMCIA data card (if installed) and can be played back. The Speech Board (Item 94) generates the audible voice prompts during SAED mode. Speech output is routed to the Speech Board in the Top Enclosure Assembly (Item 22) through J105 on the Motherboard (Item 46).

1-Volt Output

The Motherboard (Item 46) communicates with the 1-V Output through a 5-pin cable connected to J212 on the Motherboard from the IO Adapter Board in the Bottom Enclosure Assembly (Ite m21).

NOTE: The 1-V Output option is not present on the MRL Lite model.

PCMCIA Interface

The Motherboard (Item 46) stores detailed treatment data and status information on the PCMCIA data card through the Memory Card Board (Item 26) via the Memory Card Cable (Item 15) connected at J207 on the Motherboard and J1 on the Memory Card Board (Item 26). Software updates and configuration parameters may be programmed using the PCMCIA data card.

NOTE: The PCMCIA data card slot is not present on the MRL Lite model.

Blood Pressure

The Motherboard (Item 46) communicates with the Blood Pressure Board (Item 92) through the Main Blood Pressure Cable (Item 93) connected to J215 on the Motherboard and J4 on the Blood Pressure Board. In addition, the Pump/Valve Assembly (Item 69), containing the pump, valve, and pressure sensor, is connected to the Blood Pressure Board by a combination of three 2-pin cables ending in a 7-pin connector at J5. The Main Blood Pressure Hose (Item 74) connects the patient input to the valve. The temperature sensor is connected to the unit at the Input Panel (Item 24). The temperature circuitry is isolated from the chassis ground.

The route taken by the temperature signal to the Blood Pressure Board (Item 92) depends on the oximeter used. If an MRL Oximeter is used, the temperature signal is routed to the Temperature/Ox Interface Board (Item 75) and then travels via a 5-pin cable to J2 of the Blood Pressure Board. If a Nellcor Oximeter is used, the temperature signal is routed through a 10-pin Blood Pressure Cable (Item 87) that connects to J1 of the Blood Pressure Board.

Oximeter

The PIC can be equipped with either an MRL Oximeter or Nellcor Oximeter.

MRL Oximeter

The Motherboard (Item 46) communicates with the MRL Oximeter Board (Item 90) via the Main Oximeter Cable (Item 91) connected to J221 on the Motherboard and J2 on the MRL Oximeter Board. At J3, the MRL Oximeter Board (Item 90) is connected to the Temperature/ Ox Interface Board (Item 75) by a 7-pin cable. The oximeter probe is connected to a connector in the Input Panel (Item 24). The signal is then routed to a connector on the Temperature/Ox Interface Board (Item 75) and to J3 of the MRL Oximeter Board (Item 90).

Nellcor Oximeter

The Motherboard (Item 46) communicates with the CO2/Ox Isolation Board (Item 103) via the Main Oximeter Cable (Item 91) connected to J221 on the Motherboard and J2 on the CO2/Ox Isolation Board. The signal from the oximeter probe travels through the Patient Input Panel (Item 24) to J3 of the CO2/Ox Isolation Board via Item 77. The signal is then routed to the Nellcor Oximeter module via J1 and J5 of the CO2/Ox Isolation Board.

Defibrillator/External Pacemaker

The Defibrillator Module (Item 23), 5-Lead or 12-Lead ECG Preamp Board (Item 51 or 84), and 5-Lead or 12-Lead Paddle Preamp Board (Item 27 or 83) perform the following functions:

- Defibrillation
- Synchronized Cardioversion
- Transthoracic Pacing
- ECG Pickup from the Paddle Set

The Defibrillator Module transmits to and receives commands from the Motherboard (Item 46) through 5-Lead or 12-Lead Preamp-Motherboard Cable (Item 52 or 82). The defibrillator continuously checks communications integrity and requires that communication be established for operation of these functions.

Defibrillation

The defibrillator uses a capacitor bank to store enough charge to deliver a properly formed energy pulse to the patient. The charge is initiated by pressing the Front Panel Charge Switch, which causes the Motherboard (Item 46) to send a message to the defibrillator, initiating the charge sequence. Bulk power for the defibrillator is provided through the 12-Volt cable which connects to the Power Supply Board (Item 44) at J7. If bulk power is not present, the defibrillator displays an Error Bulk 12V message appears on the Display and is sent to the Chart Recorder (Item 36).

The defibrillator updates the Selected Energy display and Energy Bar as it is charging. When the defibrillator has stored the proper amount of energy, it will accept the fire command from the various paddle sets. To deliver energy to the patient, the defibrillator first activates the appropriate transfer relays connecting the patient to the defibrillator through the paddle set, paddle connector, and internal connections. Once the connection is established, the defibrillator activates Solid State Devices which connect the patient to the Charge Storage Devices. The defibrillator monitors the energy being delivered and terminates the pulse at the appropriate time.

Synchronized Cardioversion

Synchronized cardioversion follows the same sequence as described in the Defibrillator Module section except for the energy delivery trigger event. When an operator depresses the Sync Switch on the Front Panel, a message is sent to the defibrillator through 5-Lead or 12-Lead Preamp-Motherboard Cable (Item 52 or 82) informing the defibrillator to wait for a QRS event from the 5-Lead or 12-Lead ECG Preamp Board (Item 51 or 84). The Motherboard (Item 46) illuminates the Sync LED when the SYNC mode is active. When the defibrillator receives a QRS event from the preamp, it sends a message to the Motherboard (Item 46) causing the Sync LED to extinguish for a brief period indicating that the 5-Lead or 12-Lead ECG Preamp Board (Item 51 or 84) is detecting and sending valid QRS events to the Defibrillator Module (Item 23). In SYNC mode, the Display and Chart Recorder mark individual QRS pulses to indicate the pulses are being recognized.

Transthoracic Pacing

The Defibrillator Module (Item 23) or Pacer delivers constant current rectangular pacing pulses to the patient through the Hands-Free Defibrillator Cable set. The Defibrillator Module requires a valid connection at both the Hands-Free Paddle set and the Patient cable. Corrective action messages (for the operator) appear in the Pacer area of the display. The Defibrillator Module (Item 23) uses QRS events, as described in the Synchronized Cardioversion section, to operate in the Demand mode.

The operating parameters of the Pacemaker are determined by the operator and displayed in the Pacer area of the display.

- In the Demand Mode, the Pacer will not put out a pulse for a period of time after a QRS Event from the patient until the time inteval indicated in the rate setting has elapsed. If the patient’s rate is faster than the rate set for the Pacer, the Pacer will not put out pulses.
- In the ASYNC Mode, the Pacer outputs pulses at the rate set by the operator, independent of the patient’s own rate.

Paddle Pickup

When the PIC is in the Paddle Pickup Mode, the path for ECG information is from the Paddle electrodes through the Defibrillator Module (Item 23) to J3 of 5-Lead Paddle Preamp Board (Ite m27) or J1 of 12-Lead Paddle Preamp Board (Item 83)

Options

12-Lead ECG

ECG signals can be monitored from the patient cable or the paddle set. ECG signals from the patient cable pass through the 12-Lead Protection Board (Item 88) to J4 and J5 of the 12-Lead Paddle Preamp Board (Item 83) and on to the 12-Lead ECG Preamp Board (Item 84) via a 22-pin FFC Preamp Protection Cable (Item 81). The cable is connected from J2 of the 12-Lead ECG Preamp Board to J3 of the 12-Lead Paddle Preamp Board, and is sheathed with an insulating shrink-tube barrier to isolate patient-connected signals from grounded circuitry. ECG signals from the paddle set or hands-free adapter pass from the Defibrillator Module (Item 23) to J1 of the 12-Lead Paddle Preamp Board where it passes through a gain stage and an analog optocoupler before being routed through the Preamp Protection Cable (Item 81).

The 12-Lead Protection Board (Item 88) contains EMI and defibrillator protection circuitry and an AAMI standard 12-pin connector. The 12-Lead Paddle Preamp Board (Item 83) contains the paddle pickup preamplifier, protection circuitry, and the impedance transformers for detecting paddle set and pacer pad lead faults.

The 12-Lead ECG Preamp Board (Item 84) contains ECG gain and filtering circuitry, QRS detection circuitry, lead fault detection circuits, and pace detection/blanking circuits. A microprocessor on the 12-Lead ECG samples and digitizes the ECG and sends the data to the Motherboard (Item 46) via an opto-isolated serial bus. Communication to the Motherboard passes through a 22-pin FFC Motherboard Cable (Item 82) connected to J104 of the Motherboard and J5 of the 12-Lead ECG Preamp Board. In addition, the QRS Sync pulse to the Defibrillator Module (Item 23) and the Pace Blanking signal from the defibrillator pass through Item 19 via the Motherboard. The optocouplers and digital buffers on the ECG Preamp Board are powered by +5VDC. The rest of the 12-Lead ECG Preamp Board is powered through an isolated supply by the 11VDC supply. The 11VDC supply is fused on the 12-Lead ECG Preamp Board.

IBP

The Motherboard (Item 46) communicates with the Blood Pressure Board (Item 92) via the Main Blood Pressure Cable (Item 93) connected to J215 on the Motherboard and J4 on the Blood Pressure Board. The signals from the IBP1 and IBP2 probes travel through the Patient Input Panel (Item 24) to J1 via a 9-pin cable. An isolated supply runs off 11VDC and through fuses F2 and F3 in the Patient Input Panel.

CO_2

The Motherboard (Item 46) communicates with the CO_2/Ox Isolation Board (Item 103) through the CO_2-Motherboard Cable (Item 18) connected to J219 on the Motherboard and J4 on the CO_2/Ox Isolation Board. The CO_2 probe is plugged into a connector in the Patient Input Panel (Item 24). The signal from the probe is routed through the Oximeter Board Connector Cable (Item 77) to the CO_2/Ox Isolation Board connected at J3. Power to the CO_2 Module passes through a fuse, F1, in the Patient Input Panel.

Data/ Communications

Data can be sent and received through the Data/Communications Port. Signals are of RS232 ± 5V levels and are sent to and from J222 on the Motherboard (Item 46) via the Data Comm Cable from the I/O Adapter Board (Item 122) in the Bottom Enclosure Assembly (Item 21).

Fax

The Motherboard (Item 46) communicates with the Fax/Modem Board (Item 105) through a 14-pin IDC cable connected to the Fax/Modem Board and at J224 on the Motherboard. The 5-pin fax output cable, connected to the I/O Adapter Board (Item 101 or 122) in the Bottom Enclosure Assembly (Item 21), connects the external phone connection to J5 on the Fax/Modem Board (Item 105).

NOTE: The fax option is only available on units equipped with the 12-lead ECG option.

CHAPTER 7: TROUBLESHOOTING GUIDE

This chapter has troubleshooting tables that list possible malfunctions or error messages that may occur in the PIC system. The first table lists the malfunctions, the probable causes, and corrective actions to perform. The second table is a list of error messages, the probable causes, and the corrective actions to perform. The chapter ends with an illustration and explanation of how to troubleshoot the power source and gives the correct pin output voltages.

Chapter Overview:

- *Malfunctions 7.1*
- *Error Messages 7.9*
- *Power Supply Outputs 7.14*

Malfunctions

The following table describes possible malfunctions situations that could occur with the PIC system. Probable causes and suggested corrective actions are included for each type of malfunction.

NOTE: Where possible, item and part numbers are included with the corrective action. If needed, see Chapter 10 to obtain a specific part number for an item that is associated with multiple part numbers.

Malfunction	Probable Cause	Corrective Action
Delivers 10 or fewer shocks with charged battery	Batteries not properly reconditioned	Recondition battery Check expiration date on battery (See Chapter 3)
	Failure of power supply	Check Power Supply Board, Item 44 (590337)

Failure to charge	Failure of charge switch on front panel	Check Charge Switch on Top Enclosure, Item 22 (See Chapter 10)
	Front panel motherboard cable/connector faulty or damaged	Check Front Panel Cable, Item 31 (550730)
	Failure of charge switch on paddle set (damaged paddle set)	Check paddle set
	Failure of paddle set cable/ connector	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defibrillator circuit error	Check Defibrillator Module, Item 23 (596327 or 597327)
	Motherboard circuit error	Check Motherboard, Item46 (590329 or 591329)
	Motherboard-defib communications error (damaged or faulty cable)	Check Main Defib Cable, Item 19 (550721)
	System does not recognize paddle set (“Connect Paddle” warning message on main display)	Confirm use of MRL paddles Check that paddle set connector is properly seated
Delivers low energy	Defibrillator circuit error	Check Defibrillator Module, Item 23 (596327 or 597327)
Unable to set defibrillator energy	Improper energy setting Damaged cable or connector	Check Front Panel Cable, Item 31 (550730)
	Improper energy setting Damaged energy switch on front panel	Check Select Energy Switch on Top Enclosure, Item 22 (See Chapter 10)
Failure to deliver energy	Defibrillator circuit error	Check Defibrillator Module, Item 23 (596327 or 597327)
	Discharge (fire) switch failure	Replace paddle set and test
	Failed or damaged paddle cable	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Faulty or damaged paddle set	Replace paddle set and test
Failure to fire in sync mode	Failed or damaged paddle cable, patient cable, or hands-free cable	Check paddle set/ patient cable
	QRS not sent to defib Internal cable defective	Check Main Defib Cable, Item 19 (550721)
	Motherboard circuit failure	Check Motherboard, Item 46 (590329 or 591329)

Artifact on ECG	Damaged patient cable	Check patient cable
	Incorrect patient cable (incompatible, low quality, non-MRL)	Use MRL patient cables only
	Poor quality electrodes	Check expiration date on electrodes
	ECG preamp circuit failure	5 Lead: Check Pre-Amp Board, Item 51 (590328); Paddle Pre-Amp Board, Item 27 (590343) 12 Lead: Check Pre-Amp Board, Item 84 (590377); Paddle Pre-Amp Board, Item 83 (591379)
Loss of ECG signal	Patient cable not connected	Check patient cable
	Damaged patient cable	Check/replace patient cable
	Damaged hands-free cable	Check/replace hands-free cable
	Poor quality electrodes	Check expiration date on electrodes
	Faulty or damaged display	Check Display in Top Enclosure, Item 22 (See Chapter 10)
	ECG preamp input cable damaged or disconnected	Check Preamp Input Cable 5 Lead: Item 32 (550719) 12 Lead: Item 81 (550752)
	Motherboard-ECG preamp communications error	Check Motherboard, Item 46 (590329 or 591329) Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)
	Motherboard-ECG preamp cable damaged or disconnected	Check Preamp Motherboard Cable 5 Lead: Item 52 (550720) 12 Lead: Item 82 (550751)
	Preamp circuit failure	5 Lead: Check Pre-Amp Board, Item 51 (590328); Paddle Pre-Amp Board, Item 27 (590343) 12 Lead: Check Pre-Amp Board, Item 84 (590377); Paddle Pre-Amp Board, Item 83 (591379)
	Failure of power supply	Check Power Supply, Item 44 (590337)
Failure to obtain capture while pacing	Poor quality electrodes	Check expiration date on electrodes
	Incorrect current/Pacer circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)

Failure to pace	Faulty or disconnected ECG (patient) cable	Check/replace ECG Cable
	Poor quality electrodes	Check expiration date on electrodes
	Use of incorrect electrodes (incompatible, non-MRL)	Use MRL electrodes only
	Faulty or disconnected pacer cable	Check hands-free adapter cable assembly
	Defib-pacer circuit board failure	Check Defibrillator Module, Item 23 (596327 or 597327)
	Defib/pacer-Motherboard communications error (faulty or disconnected cable)	Check Main Defib Cable, Item 19 (550721)
	Failure of power supply	Check Power Supply, Item 44 (590337)
	Internal cable failure	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	ECG preamp-Motherboard communications error (faulty or disconnected cable)	Check Preamp Motherboard Cable 5 Lead: Item 52 (550720) 12 Lead: Item 82 (550751)
	ECG preamp lead fault circuitry failure	5 Lead: Check Pre-Amp Board, Item 51 (590328); Paddle Pre-Amp Board, Item 27 (590343) 12 Lead: Check Pre-Amp Board, Item 84 (590377); Paddle Pre-Amp Board, Item 83 (591379)
Inaccurate pacing current	Circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
Failure to respond to pacer controls	Front panel motherboard cable failure	Check Pacer Panel Cable, Item 30 (550729)
BP cuff does not inflate	Pump/valve assembly or cable failure	Check BP Pump/Valve Assembly, Item 69 (570519)
	BP-Motherboard communications error (faulty or disconnected cable)	Check Main Blood Pressure Cable, Item 93 (550723)
	BP module circuit failure	Check Blood Pressure Board, Item 92 (590346)
	Damaged or leaky cuff or hose	Check cuff and hose
	Cuff hose crimped of otherwise obstructed	Check hose

	Internal hose crimped or otherwise obstructed	Check Internal Hoses, Item 74 (800123) Check for possible “Air Block” message
	Failure of power supply	Check Power Supply Board, Item 44 (590337)
Inaccurate BP measurement	Use of improper cuff and/or hose (incompatible, non-MRL)	Use proper size cuff for patient’s arm size. Make sure cuff is not too loose or too tight. See PIC User Instruction Manual.
	Motion artifact	Eliminate source of motion
	BP module circuit failure/ out of calibration	Check Blood Pressure Board, Item 92 (590346)
Failure to obtain oximeter measurement	Probe failure	Check/replace probe
	Failure of internal cable	Check Temperature/OX Interface Board Item 75 (590372)
	Oximeter-Motherboard cable faulty or disconnected	Check Main Oximeter Cable, Item 91 (550722)
	Failure of oximeter board	Check Oximeter Board, Item 90 (590340)
	Faulty or damaged probe	Check/replace probe
	Oximeter probe-oximeter board cable failure	Check Input Panel and Connectors, Item 24 (See Chapter 10)
	Failure of power supply	Check Power Supply Board, Item 44 (590337)
Inaccurate oximeter measurement	Probe failure	Check/replace probe
	Oximeter circuit failure	Check Oximeter Board, Item 90 (590340)
Failure to respond to controls - device turned on	Failure of power supply	Check Power Supply Board, Item 44 (590337)
	Front panel motherboard cable damaged or disconnected	Check Front Panel Cable, Item 31 (550730); Pacer Panel Cable, Item 30 (550729)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)

Failure to turn on	Failed power switch	Check Power Switch and Cable, Items 58 and 57 (500274 and 550733)
	Power supply circuit failure	Check Power Supply Board, Item 44 (590337)
	Battery failure	Recondition/replace battery
	Motherboard circuit failure	If power supply is OK, or if LED's on front panel are lit, but display, chart recorder and beeper don't function, check Motherboard, Item 46 (590329 or 591329)
Unit shuts off without issuing "Low Battery" warning	Battery failure	Recondition/replace battery
	Power supply circuit failure	Check Power Supply Board, Item 44 (590337)
	Motherboard circuit failure	Check Motherboard, Item 46 (590329 or 591329)
Unit does not run on AC power	Failure of paddle tray/AC power supply	If AC PWR light does not illuminate when line cord is plugged in, check/replace Paddle Tray/AC Supply Module, Item 17 (971029)
	Failure of battery board	Check Battery Board, Item 54 (590353) and connector to power supply board
	Failure of power supply board	Check Power Supply Board, Item 44 (590337)
Failure of quick charger	Damaged contact pins	Check Quick Charger (971104)
	Incorrect line voltage	Check Quick Charger (971104)
	Ingress of liquids	Check Quick Charger (971104)
	Use of charger to charge non-MRL battery	Check Quick Charger (971104)
Failure of Advisory module to prompt	Speech board circuit failure	Check Speech Board, Item 94 (590345)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)
	Speech failure - speaker cable or speaker	Check Speaker Assembly, Item 55 (550712)

Inappropriate Advisory module prompt	Artifact or motion corrupts signal (bad electrodes)	Check expiration date on electrodes
	ECG preamp circuit failure	5 Lead: Check Pre-Amp Board, Item 51 (590328); Check Paddle Pre-Amp Board, Item 27 (590343) 12 Lead: Check Pre-Amp Board, Item 84 (590377); Check Paddle Pre-Amp Board, Item 83 (591379)
Failure to obtain temperature measurement	Faulty temperature probe	Check/replace probe
	BP/ temp module circuit failure	Check Blood Pressure Board, Item 92 (590346)
	BP-Motherboard communications error (faulty or disconnected cable)	Check Main Blood Pressure Cable, Item 93 (550723)
	Faulty temperature input cable/board	Check Temperature Board Assembly, Item 75 (590372), and input panel Item 24 (See Chapter 10)
Inaccurate temperature measurement	BP/temp module circuit failure	Check Blood Pressure Board, Item 92 (590346)
	Improper probe (incompatible, non-MRL)	Use MRL temperature probes only
Failure to obtain respiration measurement	Patient cable not connected	Check patient cable
	Damaged patient cable	Check/replace patient cable
	Damaged hands-free cable	Check/replace hands-free cable
	ECG preamp circuit failure	5 Lead: Check Pre-Amp Board, Item 51 (590328); Paddle Pre-Amp Board, Item 27 (590343)
	ECG preamp circuit failure	12 Lead: Check Pre-Amp Board, Item 84 (590377); Paddle Pre-Amp Board, Item 83 (591379)
	ECG preamp-Motherboard cable damaged or disconnected	Check Preamp Motherboard Cable 5 Lead: Item 52 (550720) 12 Lead: Item 82 (550751)
Inaccurate respiration measurement	Poor quality electrodes (patient motion corrupts signal)	Check expiration date on electrodes
	Incorrect electrodes (incompatible, non-MRL)	Use MRL electrodes only

	Motion artifact	Take steps to eliminate source of motion
Incorrect ECG frequency response	ECG preamp circuit failure	Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)
Improper lead fault indication	ECG preamp-Motherboard communication failure (faulty or disconnected cable)	Check Preamp Motherboard Cable 5 Lead: Item 52 (550720) 12 Lead: Item 82 (550751)
	ECG preamp circuit failure	Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)
Loss of display or lines on display	Display cable faulty or disconnected	Check Display Cable Flat Panel: Item 50 (550726 EL: Item 71 (550711) Mono LCD: Item 35 (550753) Color: Display cable glued to Color Display Board Assembly, Item 71 (550711)
	Faulty display adapter board	Check Display Adapter Board Color: Item 85 (590373) EL: Item 89 (590341) Mono: Item49 (590382)
	Damaged or faulty display	Check display part of Top Enclosure, Item 22 (See Chapter 10)
	Motherboard circuit failure	Check Motherboard Item 46 (590329 or 591329)

Error Messages

The following table lists the PIC system error messages. Probable causes and suggeted corrective actions are included for each error message.

NOTE: Where possible, item and part numbers are included with the corrective action. If needed, see Chapter 10 to obtain a specific part number for an item that is associated with multiple part numbers.

Error Message	Probable Cause	Corrective Action
xxx button fail	Faulty or damaged front panel	Check Switches on Front Panel of Top Enclosure, Item 22 (See Chapter 10)
	Front panel - motherboard cable faulty or disconnected	Check Front Panel Cable, Item 31 (550730)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)
Ox Comm Fail	Oximeter - motherboard cable faulty or disconnected	Check Main Oximeter Cable, Item 91 (550722)
	Motherboard hardware error	Check Motherboard, Item 46 (590329 or 591329)
	Oximeter hardware error	Check Oximeter Board, Item 90 (590340) or Item 103 (590390)
Ox AC Path Err	Oximeter circuit error	Check Oximeter Board, Item 90 (590340) or Item 103 (590390)
	Probe error	Check Oximeter probe
Ox DC Path Err	Oximeter circuit error	Check Oximeter Board, Item 90 (590340) or Item 103 (590390)
Ox Buffer Err	Oximeter circuit error	Check Oximeter Board, Item 90 (590340) or Item 103 (590390)
Ox Chksum Err	Oximeter circuit error	Check Oximeter Board, Item 90 (590340) or Item 103 (590390)
BP Comm Fail	BP - Motherboard cable faulty or disconnected	Check Main Blood Pressure Cable, Item 93 (550723)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)
	BP circuit error	Check Blood Pressure Board, Item 92 (590346)

Temp A/D Err	BP circuit error	Check Blood Pressure Board, Item 92 (590346)
BP RAM Err	BP circuit error	Check Blood Pressure Board, Item 92 (590346)
BP DC Path Err	BP circuit error	Check Blood Pressure Board, Item 92 (590346)
BP Chksum Err	BP circuit error	Check Blood Pressure Board, Item 92 (590346)
DefibCommFail	Defib cable faulty or disconnected	Check Main Defib Cable, Item 19 (550721)
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
ApexFire ButnFail	Faulty or damaged paddle set	Check paddle set
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
SternemFire ButnFail	Faulty or damaged paddle set	Check paddle set
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PdlCharge ButnFail	Faulty or damaged paddle set	Check paddle set
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PdlEnergyUp ButnFail	Faulty or damaged paddle set	Check paddle set
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)

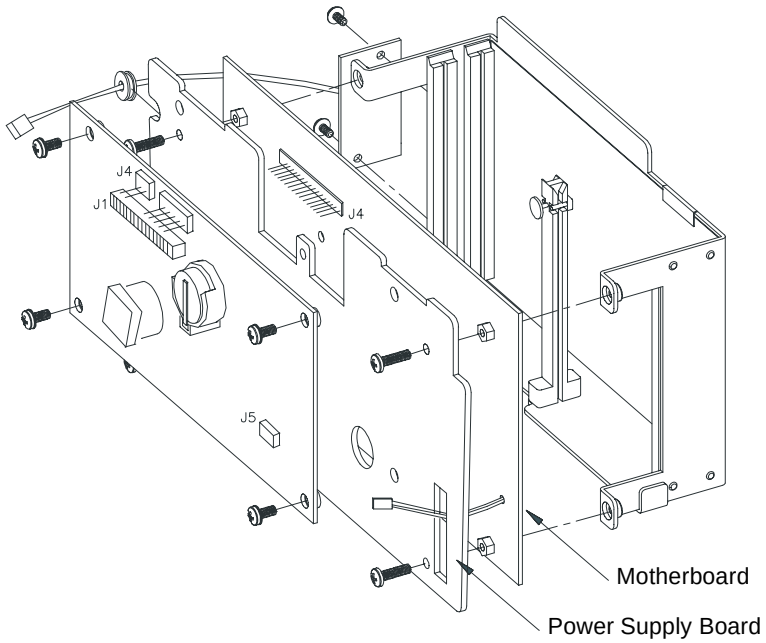
PdlEnergyDn ButnFail	Faulty or damaged paddle set	Check paddle set
	Paddle set cable damaged	Check paddle set connector/ cable on Top Enclosure, Item 22 (See Chapter 10)
	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr: Chksum	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr:SPI	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr:008	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr:009	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr:010	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr:011	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
DefibErr: 12V Bulk	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
	Power supply defib cable faulty or disconnected	Check Defib-Power Supply Cable on Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:013	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:014	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:015	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:016	Simulator related -Text fixture error	Check/disconnect test fixture-should be 50 to 700 Ohms
PaceErr:017	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:018	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:019	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:020	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PaceErr:021	Defib circuit failure	Check Defibrillator Module, Item 23 (596327 or 597327)
PreampA/DErr	Preamp circuit error	Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)

Preamp QRS Det Err	Preamp circuit error	Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)
Preamp Lead Test Err	Preamp circuit error	Check Preamp Board 5 Lead: Item 51 (590328) 12 Lead: Item 84 (590377)
Bad SAED Transition	Motherboard circuit error	Cycle unit power. Check Motherboard, Item 46 (590329 or 591329)
Card Fail	Memory card not formatted	Format the memory card
	Memory card faulty	Check/replace memory card
	Memory card circuit board failure	Check/replace Memory Card Board, Item 26, (590344)
	Memory card-Motherboard cable faulty or disconnected	Check Memory Card Cable, Item 15 (550706)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)
SpeechInitErr	Speech board circuit error	Check Speech Board, Item 94 (590345)
	Motherboard circuit error	Check Motherboard, Item 46 (590329 or 591329)
Preamp cableset fail	Main/preamp cable faulty or disconnected	Check Main Preamp Cable, Item 52 (550720)
Modem init fail	Modem circuit failure	Check Fax/Modem, Item 105 (590384, 593384, or 595384)
	Modem-Motherboard cable not connected	Check Fax/Modem, Item 105 (590384, 593384, or 595384) and connector to Motherboard Item 46 (590329 or 591329)
Remote fax busy	Phone line busy	Attempt to resend fax
No answer at remote fax	Connection terminated by receiving fax	Attempt to resend fax
Page send failed	Connection terminated by receiving fax	Attempt to resend fax
Modem timeout during modem response	Connection terminated by receiving fax	Attempt to resend fax
Page send failed	Incompatible cellular phone or adapter	Only use cellular phones and adapters recommended by MRL
	Connection terminated by receiving fax	Attempt to resend fax

No carrier detected or carrier lost	External cable failed	Check external cable
	Incompatible cellular phone or adapter	Only use cellular phones and adapters recommended by MRL
No dialtone detected	External cable not connected	Check external cable
	Line in use by another phone	Check for another phone off the hook on same line
	Fax output cable not connected correctly	Check Fax Output Cable on 1V/ Fax Output Board, Item 104 (590357) and connection to Fax/Modem Board, Item 105 (590384, 593384, or 595384)

Power Supply Outputs

To troubleshoot the Power Supply Board, Item 44, check for voltage on J1 (J4 on the Motherboard, Item 46) as indicated below. Note that PIN 1 of J1 is located next to the transformer T2.



PIN	Voltage
1	+11V ±0.2V
2	+5V ±0.2V
3	-5V ±0.3V

CHAPTER 8: REMOVAL AND REPLACEMENT INSTRUCTIONS

This chapter provides the instructions for the removal and replacement of each of the various assemblies and components of the Portable Intensive Care (PIC) system.

Chapter Overview:

- *Required Tools. 8.1*
- *List of Items 8.2*
- *Removal and Replacement Instructions 8.4*

WARNING: ***Unplug the AC power cable and remove the battery before servicing the PIC.***

CAUTION: ***Use only the replacement parts and assemblies recommended in this manual. In many cases, substitute parts may not be suitable to insure reliable performance. For example: the RTV sealant (Item 37), called for in several procedures, must be electronic-grade. Standard grades of RTV are not acceptable because they can be corrosive during their curing process.***

NOTE: *Refer to the assembly drawings in Chapter 9 and the troubleshooting tables in Chapter 10 of this manual for additional information.*

Required Tools

- #1 Phillips round-blade screw driver
- #2 Phillips round-blade screw driver
- #2 Phillips pin-head screw driver (MRL Part Number 002109)
- Long-nose pliers

List of Items

- Item 15 – Main Memory Card Cable 8.4
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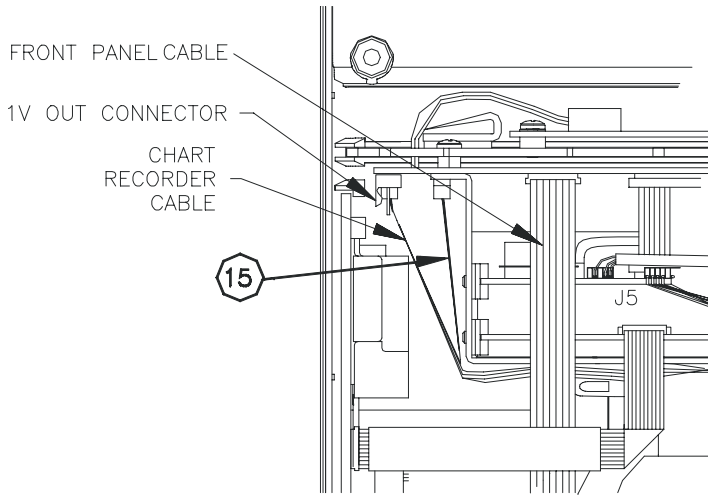
Item 15 - Main Memory Card Cable



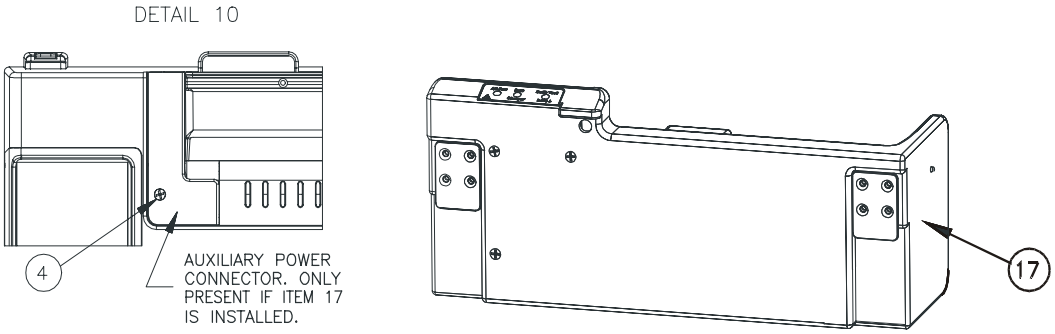
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26).
3. Disconnect Main Memory Card Cable (Item 15) at J1 by pulling up on connector.
4. Disconnect Fax Output Cable at J5 of Modem Board (Item 105) and 1 V Output Cable at J212 of Motherboard (Item 46), if Fax/Modem and/or 1 V Output option is installed.
5. Disconnect Main Memory Cable (Item 15) at J207 on Motherboard (Item 46) by pulling up on connector.

REPLACE

1. Connect Main Memory Card Cable (Item 15) at J207 on Motherboard (Item 46), matching notches.
2. Connect Fax Output Cable at J5 to Modem Board (Item 105) and 1 V Output Cable at J212 to Motherboard (Item 46), if Fax/Modem and/or 1 V Output option was installed.
3. Connect Main Memory Card Cable (Item 15) at J1 on Memory Card Board (Item 46), matching notches.
4. Replace Memory Card Board (Item 26) in unit with J1 facing into the unit, line up holes, and fasten with screws (Item 5).
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 17 – AC Supply/Paddle Tray Module



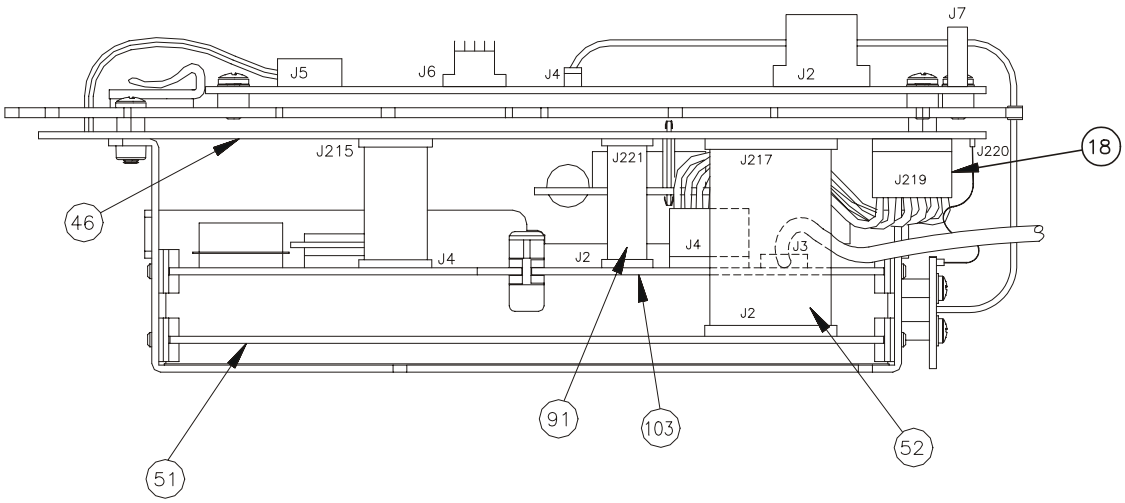
REMOVE

1. Remove Input Panel (Item 24).
2. Remove one screw (Item 4) from Auxiliary Power Connector using a #2 Phillips head screwdriver.
3. Lift up Auxiliary Power Connector.
4. Slide AC Supply / Paddle Tray Module (Item 17) up along the back side of the unit.

REPLACE

1. Slide AC Supply / Paddle Tray Module (Item 17) down along the back side of the unit. Both metal clips should lock into place.
2. Push Auxiliary Power Connector down onto the top of the unit making sure the 4 white plastic connectors are pushed into the correct holes.
3. Replace one screw (Item 4) into Auxiliary Power Connector using a #2 Phillips head screwdriver.
4. Replace Input Panel (Item 24).

Item 18 – CO_2 Cable



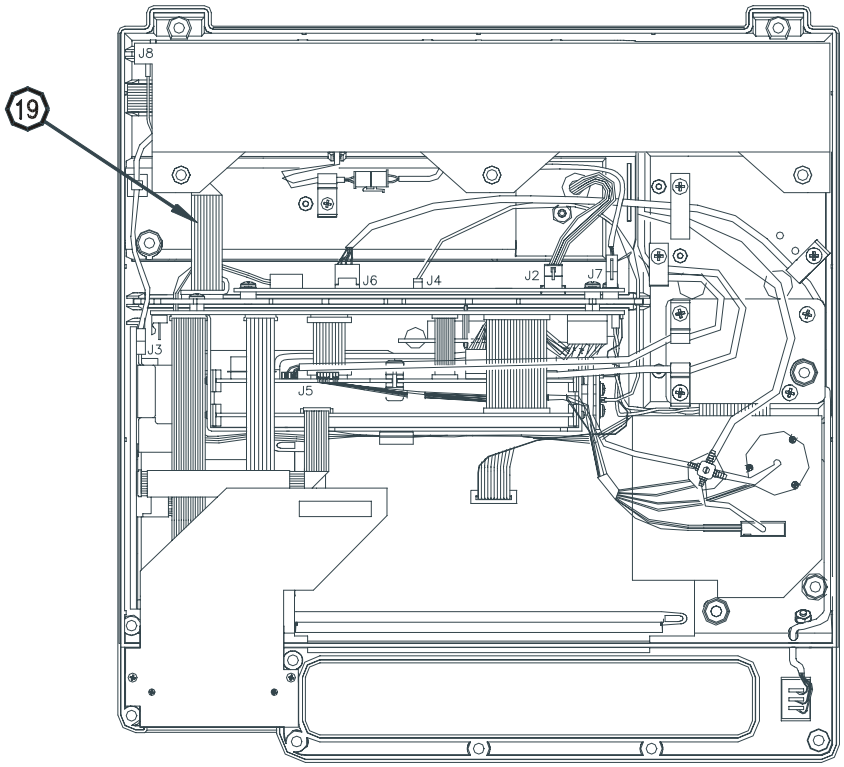
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. If a 5-Lead model, disconnect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pulling on the cable.
3. Disconnect CO_2 Cable (Item 18) from Oximeter Board (Item 103) at J4 by pulling on connector.
4. Disconnect CO_2 Cable (Item 18) from Motherboard (Item 46) at J219 by pulling on connector.

REPLACE

1. Connect CO_2 Cable (Item 18) to Motherboard (Item 46) at J219 by pushing connector onto metal pins.
2. Connect CO_2 Cable (Item 18) to Oximeter Board (Item 103) at J4 by pushing connector onto metal pins.
3. If a 5-Lead model, connect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pushing cable into connector. The insulated side of the cable should face the Motherboard (Item 46).
4. Check that all cables are seated correctly in and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 19 – Defib Main Cable



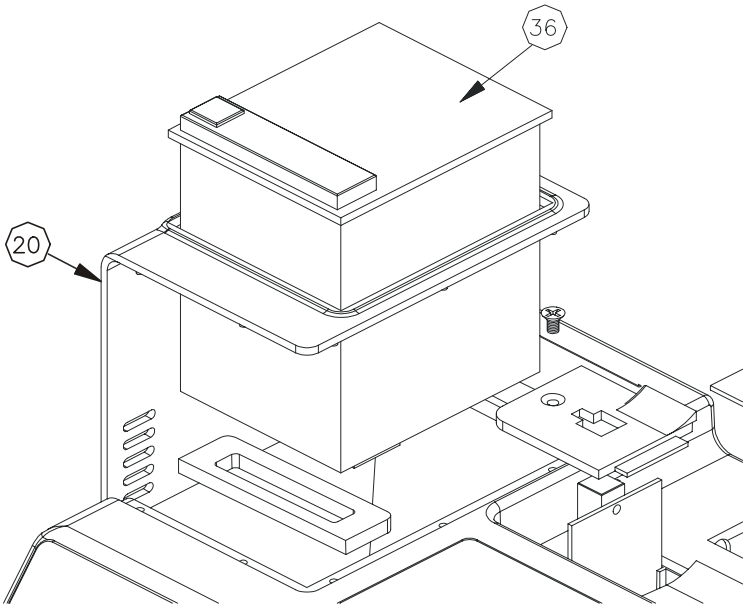
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect Chart Power Cable, at J223 on Motherboard (Item 46), from Power Supply Board (Item 44) at J5 by pulling on connector.
4. Remove Defib Main Cable (Item 19) by sliding from cable clamp on Card Cage Pre-Assembly (Item 48).
5. Disconnect Defib Main Cable (Item 19) from Motherboard (Item 46) at J218 by pulling on cable.
6. Disconnect Defib Main Cable (Item 19) from Defibrillator Module (Item 23) at J8.

REPLACE

1. Connect Defib Main Cable (Item 19) to Defibrillator Module (Item 23) at J8.
2. Connect Defib Main Cable (Item 19) to Motherboard (Item 46) at J218 by pushing cable into connector and checking that cable is seated straight; the blue side of the cable should face the outside of Card Cage Pre-Assembly (Item 48).
3. Replace cable into clamp on Card Cage Pre-Assembly (Item 48).
4. Connect Chart Power Cable, at J223 on Motherboard (Item 46), to Power Supply Board (Item 44) at J5 by pushing connector onto metal pins. Lip on female connector should go under retainer on male connector. Chart Power Cable should be over Defib Main Cable (Item 19).
5. Replace Card Cage Pre-Assembly (Item 48).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 20 – Chart Recorder Cover



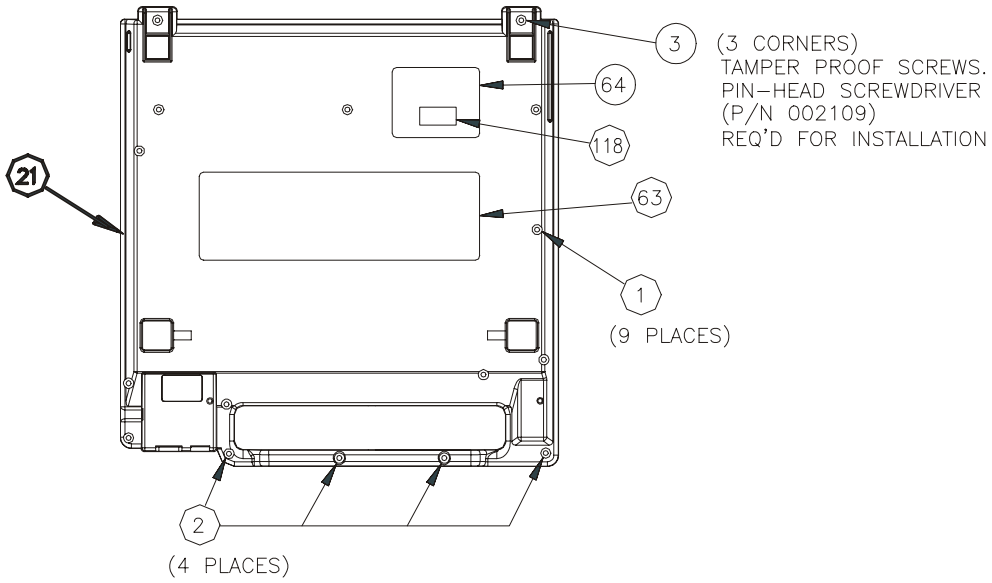
REMOVE

1. Remove Chart Recorder (Item 36).
2. Lift the Chart Recorder Cover (Item 20).

REPLACE

1. Insert Chart Recorder Cover (Item 20). Make sure it fits properly.
2. Replace Chart Recorder (Item 36).

Item 21– Bottom Enclosure



NOTE: Requires Label Kit (Item 65)

REMOVE

1. Remove three pin-head screws (Item 3) in three of the corners using a Phillips pin-head screwdriver (Service Part Number: 002109).
2. Remove four screws (Item 2) on the handle of the unit using a #2 Phillips head screwdriver.
3. Remove remaining nine screws (Item 1) located on the bottom of the unit using a #2 Phillips head screwdriver.
4. Carefully lift off Bottom Enclosure (Item 21).
5. Disconnect Fax Output Cable at J5 of Modem Board (Item 105), if Fax/Modem option is installed.

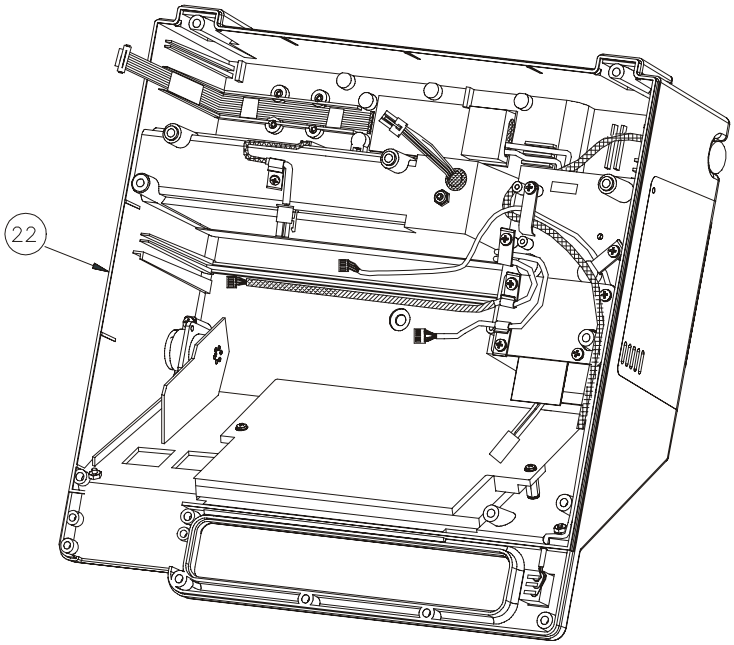
REPLACE

1. Make sure that Defibrillator Module (Item 23) is fully seated in the unit. Check that the green base of the Defibrillator Module (Item 23) is flush with the top of the 3 posts into which the Bottom Enclosure screws (Item 1) fit.

2. Make sure that all cables are pushed into the unit so that none are pinched when replacing Bottom Enclosure (Item 21). Connect Fax Output cable at J5 of Modem Board (Item 105), if Fax/Modem option is installed.
3. Carefully place Bottom Enclosure (Item 21) onto the back of the unit.
4. Replace three screws (Item 3) in the corners using a Phillips pin-head screwdriver (Service Part Number: 002109) until snug—do not over-tighten (8 in-lbs torque).
5. Replace thirteen remaining screws (Items 1 and 2) using a #2 Phillips head screwdriver until snug – do not over-tighten (8 in-lbs torque).

NOTE: If replacing with a new bottom enclosure, transfer Serial Number, Part Number, and Options on to writable label from Label Kit (Item 65). Attach over Serial Number Label (Item 64). Add maintenance log label (Item 63) from label kit (Item 65).

Item 22 – Top Enclosure Assembly



REMOVE

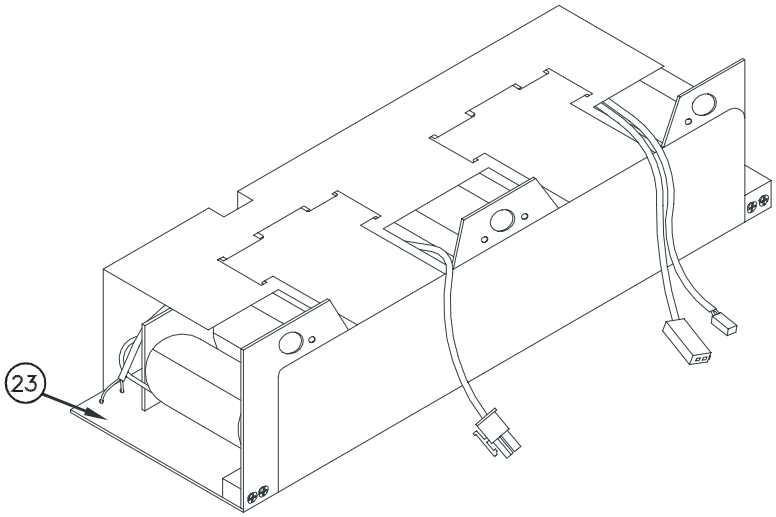
1. Remove Input Panel (Item 24).
2. Remove AC Supply / Paddle Tray Module (Item 17).
3. Remove Bottom Enclosure (Item 21).
4. Remove Card Cage Pre-Assembly (Item 48).
5. Remove Defibrillator Module (Item 23).
6. Remove Paddle Preamp Shield (Item 29).
7. Remove Paddle Preamp Board (Item 27).
8. Remove Barrier for Paddle Preamp Board (Item 28). Attached to Preamp Board for 12-Lead option.
9. Remove Chart Recorder (Item 36).
10. Remove Chart Recorder Cable (Item 53).

REPLACE

1. Replace Chart Recorder Cable (Item 53).
2. Replace Chart Recorder (Item 36).
3. Replace Barrier for Paddle Preamp Board (Item 28).

4. Replace Paddle Preamp Board (Item 27).
5. Replace Paddle Preamp Shield (Item 29).
6. Replace Defibrillator Module (Item 23).
7. Replace Card Cage Pre-Assembly (Item 48).
8. Check that cables are seated correctly in connectors and are clear of the sides of the unit.
9. Replace Bottom Enclosure (Item 21).
10. Replace AC Supply/Paddle Tray Module (Item 17).
11. Replace Input Panel (Item 24).

Item 23 – Defibrillator Module



CAUTION: Defibrillator module may maintain high voltage on capacitor bank.

REMOVE

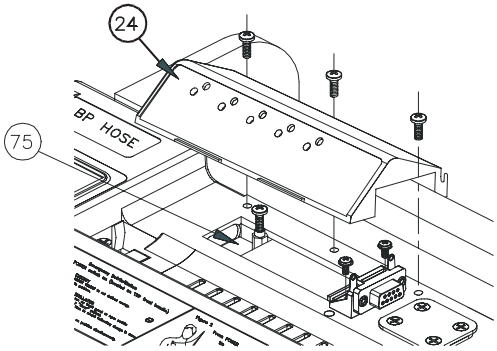
1. Remove Bottom Enclosure (Item 21).
2. Disconnect Defib Power Cable from Power Supply Board (Item 44) at J7 by pushing down on locking mechanism and pulling out.
3. Disconnect Defib Out connection by pushing down on lock and pulling apart connectors.
4. Disconnect Pad Pickup Cable from 5-Lead Paddle Preamp Board (Item 27) at J3, or 12-Lead Paddle Preamp Board (Item 83) at J1, by carefully pulling on cable.
5. Lift Defibrillator Module (Item 23) on the side where J8 is located. Disconnect Defib Main Cable (Item 19) from Defibrillator Module (Item 23) at J8 by pulling out cable.
6. Disconnect Defib Paddle Connector Cable from Defibrillator Module (Item 23) at J11.
7. Remove Defibrillator Module (Item 23) from unit.

REPLACE

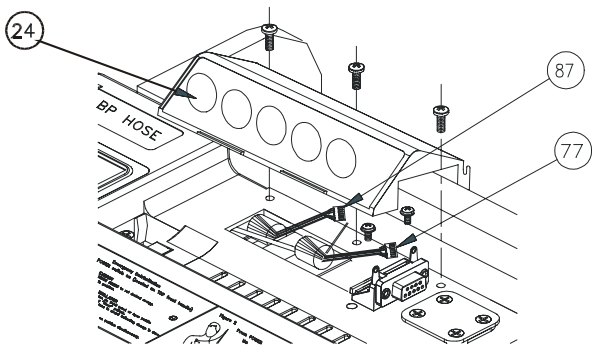
1. Connect Defib Paddle Connector Cable to Defibrillator Module (Item 23) at J11.
2. Hold Defib Paddle Connector Cable against the side wall of the unit and slide Defibrillator Module (Item 23) into the unit along the 2 rails. Defibrillator Module (Item 23) should slide in easily and should be a loose fit when in the unit.
3. Lift Defibrillator Module (Item 23) a little bit on the side where J8 is located; connect Defib Main Cable (Item 19) to Defibrillator Module (Item 23) at J8 by carefully pushing in the cable and making sure it is seated straight in the connector. The blue side of the cable should face the wall of the unit.
4. Connect Pad Pickup Cable to Paddle Preamp Board (Item 27) at J3, or (Item 83) at J1, by carefully pushing connector onto the metal pins.
5. Connect Defib Out connection by pushing down on locking mechanism and pushing connectors together.
6. Connect Defib Power cables to Power Supply Board (Item 44) at J7 by pushing down on locking mechanism and pushing onto connector.
7. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
8. Replace Bottom Enclosure (Item 21).

Item 24 – Input Panel

MRL OXIMETER OPTION– 971002



OXIMETER OPTION– 971074



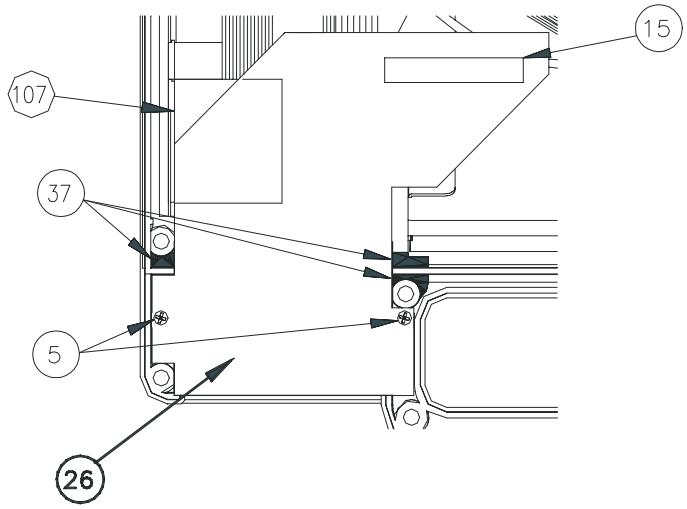
REMOVE

1. Remove three screws (Item 6) on Input Panel (Item 24) using a #1 Phillips head screwdriver.
2. Tilt Input Panel (Item 24) to the front of the unit and lift up.
3. Disconnect connectors from the Input Panel Board (if present).

REPLACE

1. Connect connectors to the Input Panel Board (if present).
2. Insert the two tabs on the front of Input Panel (Item 24) into the top of the unit. Push down into the unit.
3. Replace three screws (Item 6) into Input Panel (Item 24) using a #1 Phillips head screwdriver.

Item 26 – Memory Card Board



NOTE: Requires Silicon RTV (Item 37)

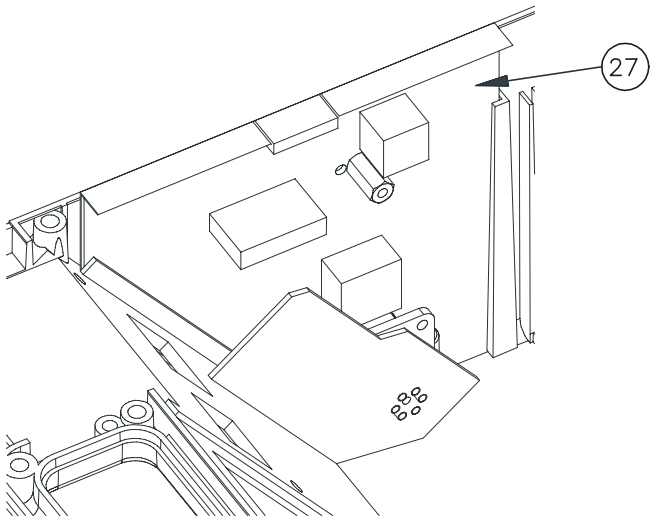
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove two screws (Item 5) securing the Memory Card Board (Item 26).
3. Carefully pull Memory Card Board (Item 26) away from unit. Disconnect Main Memory Card Cable (Item 15) at J1, by pulling on connector.

REPLACE

1. Install Memory Card Barrier (Item 107) on bottom side of Memory Card Board (Item 26) if unit has 12-lead ECG option.
2. Connect Main Memory Card Cable (Item 15) at J1, matching notches.
3. Place Memory Card Board (Item 26) in unit with J1 facing into the unit, align holes, and fasten with screws (Item 5).
4. Seal Memory Card Board (Item 26) where indicated (dark shading on picture) with RTV (Item 37).
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 27 – 5-Lead Paddle Preamp Board



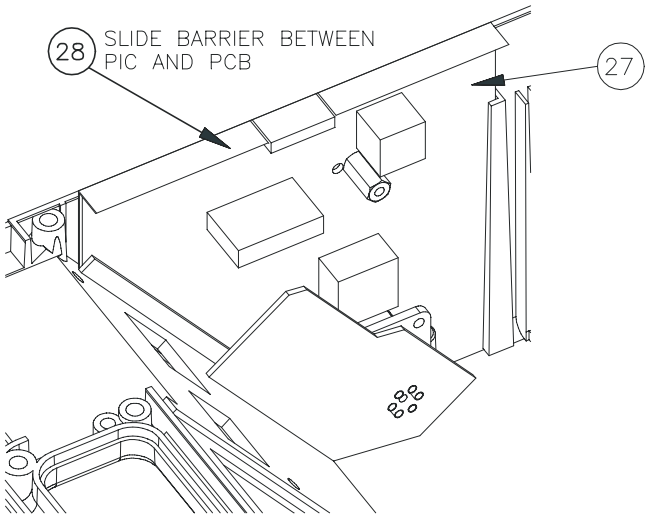
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26).
3. Remove Card Cage Pre-Assembly (Item 48).
4. Remove Paddle Preamp Shield (Item 29).
5. Disconnect ECG Input Connection from Paddle Preamp Board (Item 27) at J1 by pulling on the connector. Do not pull on the wires. (See detail 2, sheet 3, on the service assembly drawing).
6. Slide Paddle Preamp Board (Item 27) up and out of unit.

REPLACE

1. Slide Paddle Preamp Board (Item 27) into unit along the 2 rails.
2. Connect ECG Input Connection to Paddle Preamp Board (Item 27) at J1 by pushing the connector onto the metal pins. Lip on female connector should go under holder on male connector.
3. Replace Paddle Preamp Shield (Item 29).
4. Replace Card Cage Pre-Assembly (Item 48).
5. Replace Memory Card Board (Item 26).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 28 – Barrier for 5-Lead Paddle Preamp Board



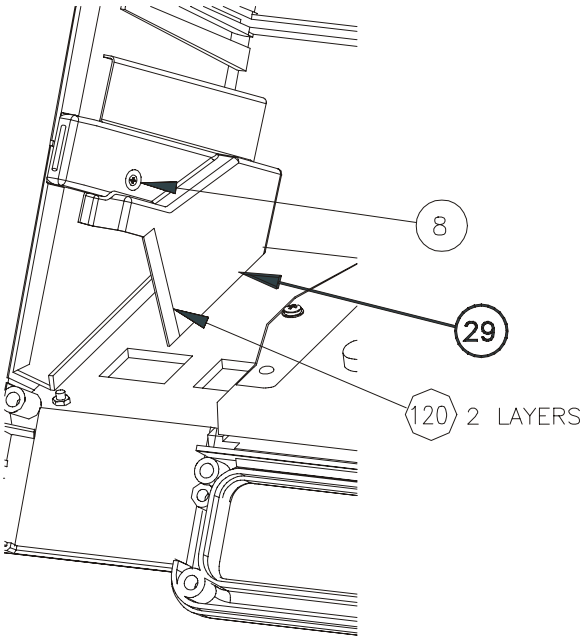
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26).
3. Remove Card Cage Pre-Assembly (Item 48).
4. Remove Paddle Preamp Shield (Item 29).
5. Remove Paddle Preamp Board (Item 27).
6. Slide Barrier for 5-Lead Paddle Preamp Board (Item 28) out of unit.

REPLACE

1. Slide Barrier for 5-Lead Paddle Preamp Board (Item 28) into unit with cut-out over Patient Input Connector (Item 40) housing.
2. Replace Paddle Preamp Board (Item 27).
3. Replace Paddle Preamp Shield (Item 29).
4. Replace Card Cage Pre-Assembly (Item 48).
5. Replace Memory Card Board (Item 26).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 29 – 5-Lead Paddle Preamp Shield



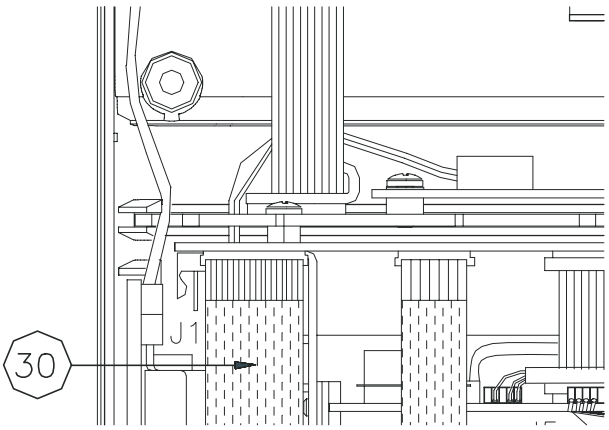
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. If option installed, remove Memory Card Board (Item 26).
3. Remove Card Cage Pre-Assembly (Item 48).
4. Remove screw and washer (Items 5 and 8) from Paddle Preamp Shield (Item 29) using a #1 Phillips head screwdriver.
5. Lift off Paddle Preamp Shield (Item 29).

REPLACE

1. Place Paddle Preamp Shield (Item 29) over Paddle Preamp Board (Item 27) and Patient Input Connector (Item 40) with screw hole line up on hex spacer on Paddle Preamp Board (Item 27).
2. Replace screw and washer (Items 5 and 8) to Paddle Preamp Shield (Item 29) using a #1 Phillips head screwdriver.
3. Replace Card Cage Pre-Assembly (Item 48).
4. Replace Memory Card Board (Item 26), if option installed.
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 30 – Pacer Panel Cable



NOTE: 12-Lead shown.

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26), if option installed.
3. Disconnect the Preamp Protection Cable (Item 32 or 81) from the Paddle Preamp Board (Item 27 or 83)
4. Disconnect Pacer Panel Cable (Item 30) from Motherboard (Item 46) at J211 by lifting retaining clip with fingernails or small instrument. Carefully remove cable.
5. Disconnect Pacer Panel Cable (Item 30) from Top Enclosure Assembly (Item 22) by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.

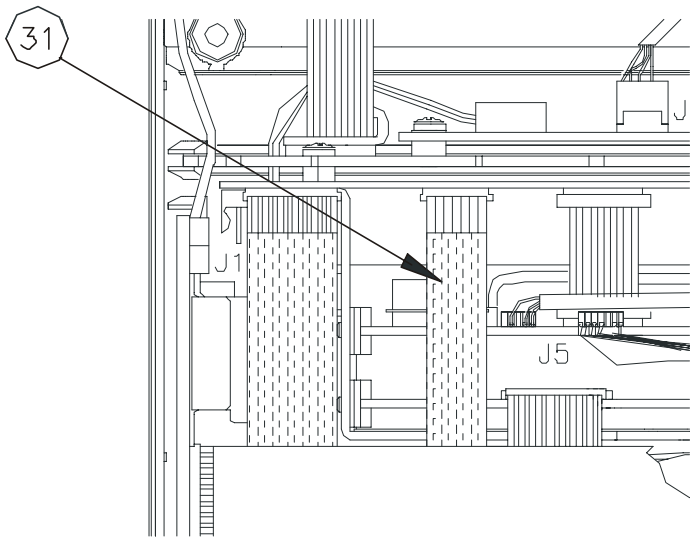
NOTE: If unit is a 12-Lead PIC, the Pacer Panel Cable (Item 30) will have a length of Shrink Tubing (Item 125) which should remain on the cable, unless damaged.

REPLACE

1. Connect Pacer Panel Cable (Item 30) to Top Enclosure Assembly (Item 22) by lifting retaining clip with fingernails or small instrument, placing cable into the connector, checking that cable is seated straight, and pushing down on the retaining clip; the insulated side of the cable should face the back of the retaining clip. Check that the Shrink Tubing (Item 125) is in place.

2. Connect Pacer Panel Cable (Item 30) to Motherboard (Item 46) at J211 by lifting retaining clip with fingernails or small instrument, placing cable into the connector, checking that cable is seated straight, and pushing down on the retaining clip; the insulated side of the cable should face the back of the retaining clip.
3. Connect the Preamp Protection Cable (Item 32 or 81) to the Paddle Preamp Board (Item 27 or 83).
4. Replace Memory Card Board (Item 26), if option was installed.
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 31 – Front Panel Cable



NOTE: 12-Lead shown.

REMOVE

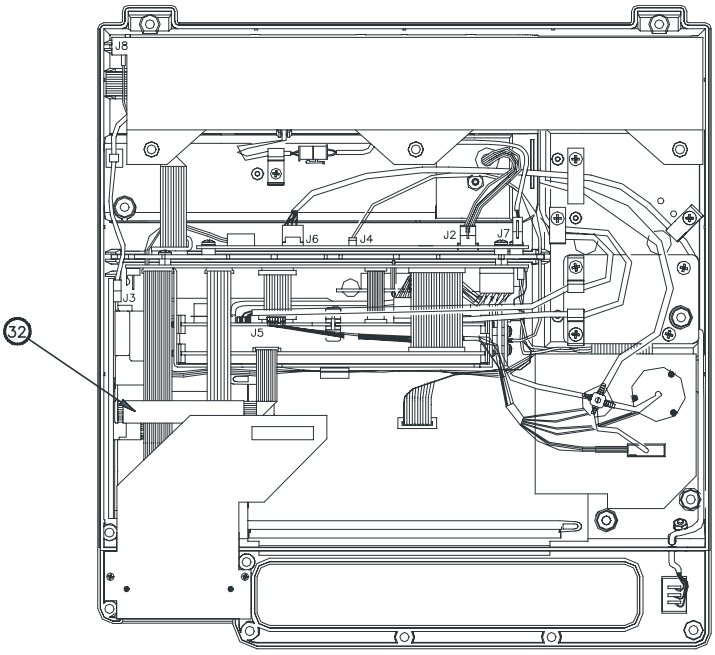
1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26), if option installed.
3. Disconnect the Preamp Protection Cable (Item 32 or 81) from the Paddle Preamp Board (Item 27 or 83).
4. Disconnect Front Panel Cable (Item 31) from Motherboard (Item 46) at J108 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
5. Disconnect Front Panel Cable (Item 31) from Top Enclosure Assembly (Item 22) by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.

NOTE: Front Panel Cable (Item 31) will have a length of Shrink Tubing (Item 126) which should remain on the cable, unless damaged.

REPLACE

1. Connect Front Panel Cable (Item 31) to Top Enclosure Assembly (Item 22) by lifting retaining clip with fingernails or small instrument, placing cable into the connector, checking that cable is seated straight, and pushing down on the retaining clip; the insulated side of the cable should face the back of the retaining clip. Make sure Shrink Tubing (Item 126) is in place.
2. Connect Front Panel Cable (Item 31) to Motherboard (Item 46) at J108 by lifting retaining clip with fingernails or small instrument, placing cable into the connector, checking that cable is seated straight, and pushing down on the retaining clip; the insulated side of the cable should face the back of the retaining clip.
3. Connect the Preamp Protection Cable (Item 32 or 81) to the Paddle Preamp Board (Item 27 or 83).
4. Replace Memory Card Board (Item 26), if option installed.
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 32 – 5-Lead Preamp-Protection Cable



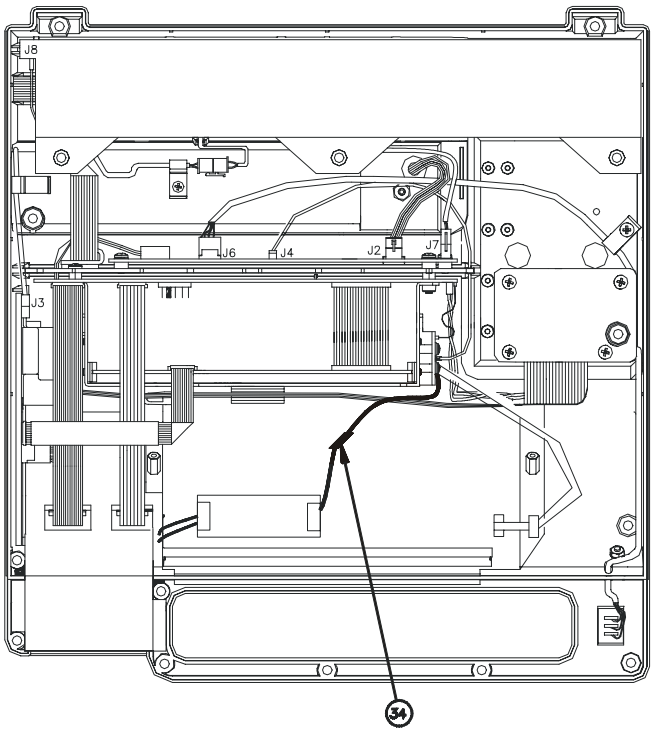
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Preamp-Protection Cable (Item 32) from Paddle Preamp Board (Item 27) at J2 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
3. Disconnect Preamp-Protection Cable (Item 32) from ECG Preamp Board (Item 51) at J3 by pulling cable out of connector.

REPLACE

1. Connect Preamp-Protection Cable (Item 32) to ECG Preamp Board (Item 51) at J3 by pushing cable into connector; the blue side of the cable should face out.
2. Connect Preamp-Protection Cable (Item 32) to Paddle Preamp Board (Item 27) at J2 by lifting retaining clip with fingernails or small instrument, placing cable into the connector, checking that cable is seated straight, and pushing down on the retaining clip; the blue side of the cable should face the back of the retaining clip.
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 34 – Mono LCD Inverter Cable



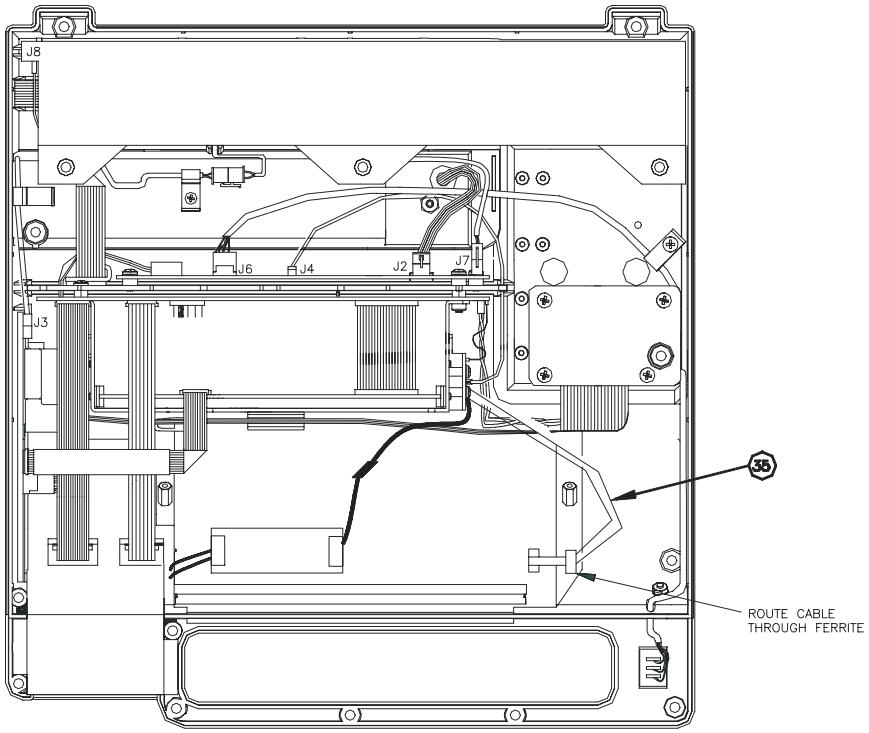
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Mono LCD Inverter Cable (Item 34) from LCD Display Adapter Board (Item 49) at J4 by pulling wires out of connector.
3. Disconnect Mono LCD Inverter Cable (Item 34) from Backlight Inverter (Item 43) at CN1 by pulling wires out of connector.

REPLACE

1. Connect Mono LCD Inverter Cable (Item 34) to LCD Display Adapter Board (Item 49) at J4 by pushing the cable into the connector; the ridged side of the cable should face out.
2. Connect Mono LCD Inverter Cable (Item 34) to Backlight Inverter (Item 43) at CN1 by pushing the cable into the connector down; the ridged side of the cable should face out.
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 35 – Mono LCD Cable



REMOVE

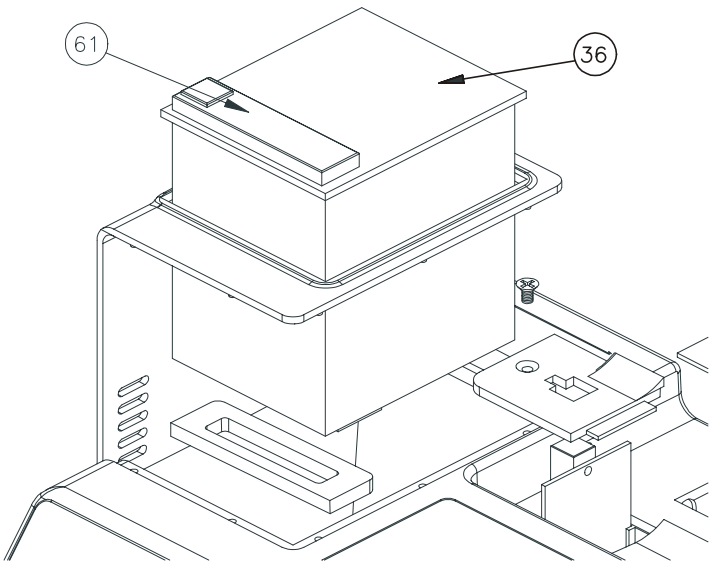
1. Remove Bottom Enclosure (Item 21).
2. Disconnect Mono LCD Cable (Item 35) from LCD Display Adapter Board (Item 49) at J5 by very carefully lifting retaining clip with fingernail or small instrument and carefully pulling out cable. (Connector is fragile).
3. Disconnect Mono LCD Cable (Item 35) from Top Enclosure Assembly (Item 22) by very carefully lifting retaining clip with fingernail or small instrument and carefully pulling out cable. (Connector is fragile).

REPLACE

1. Connect Mono LCD Cable (Item 35) to LCD Display Adapter Board (Item 49) at J5 by very carefully lifting retaining clip with fingernail or small instrument, placing cable into connector, checking that the cable is seated straight, and pushing down on retaining clip. The white side of the cable should face the back of the retaining clip. (Connector is fragile).

2. Connect Mono LCD Cable (Item 35) to Top Enclosure Assembly (Item 22) at J5 by very carefully lifting retaining clip with fingernail or small instrument, placing cable into connector, checking that the cable is seated straight, and pushing down on retaining clip. The white side of the cable should face the back of the retaining clip. (Connector is fragile).
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 36 – Chart Recorder



NOTE: Requires Label Kit (Item 65)

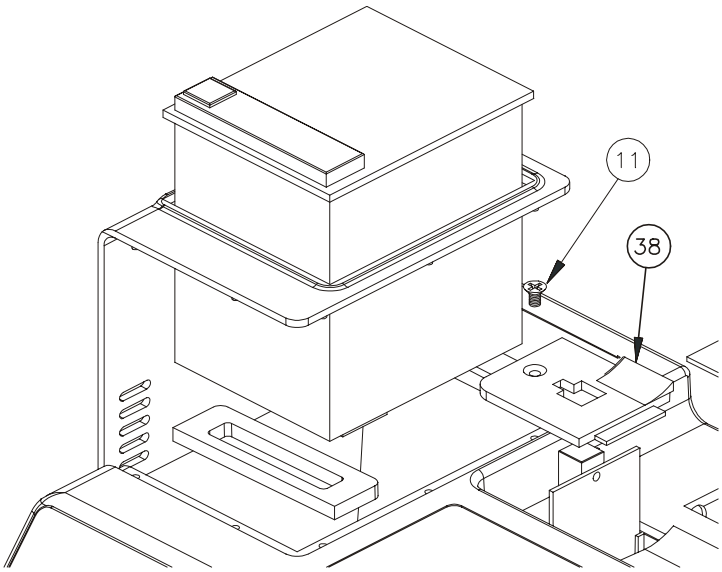
REMOVE

1. Open Chart Recorder Door and remove paper roll.
2. Remove two screws on the inside bottom of the Chart Recorder (Item 36) with a #2 Phillips head screwdriver.
3. Remove Chart Recorder (Item 36) by pulling and rocking it side to side.

REPLACE

1. Place Chart Recorder (Item 36) into unit and rock it into place; make sure that Chart Recorder (Item 36) is flush with the top of the unit.
2. Replace two screws on the inside bottom of the Chart Recorder (Item 36) with a #2 Phillips head screwdriver until snug—do not over-tighten.
3. Replace paper and close door.
4. Add labels (Items 62 and 61).

Item 38 – Battery Board Cover



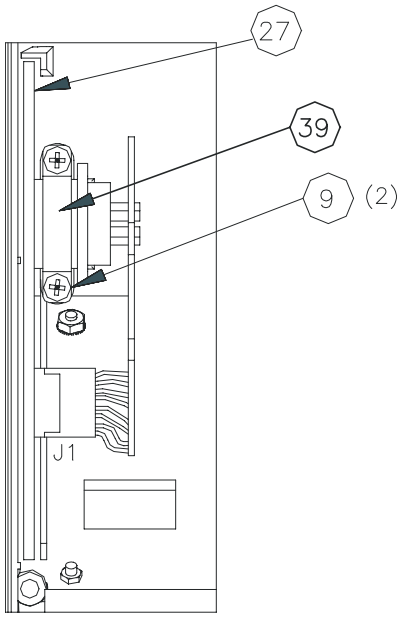
REMOVE

1. Remove Input Panel (Item 24).
2. Remove AC Supply/Paddle Tray Module (Item 17).
3. Remove screw (Item 11).
4. Lift off Battery Board Cover (Item 38).

REPLACE

1. Place Battery Board Cover (Item 38) over Battery Board (Item 54).
2. Replace screw (Item 11).
3. Replace AC Supply/Paddle Tray Module (Item 17).
4. Replace Input Panel (Item 24).

Item 39 – Patient Input Bracket (5-Lead)



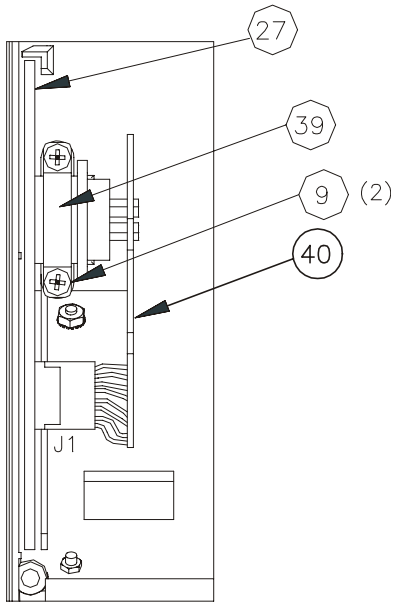
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Paddle Preamp Shield (Item 29).
4. Remove Paddle Preamp Board (Item 27).
5. Remove two screws (Item 9) on Patient Input Bracket (Item 39) with a #2 Phillips head screwdriver.
6. Lift Patient Input Bracket (Item 39).

REPLACE

1. Place Patient Input Bracket (Item 39) over the Patient Input Connector (Item 40).
2. Replace two screws (Item 9) to Patient Input Bracket (Item 39) with a #2 Phillips head screwdriver until snug—do not over-tighten.
3. Replace Paddle Preamp Board (Item 27).
4. Replace Paddle Preamp Shield (Item 29).
5. Replace Card Cage Pre-Assembly (Item 48).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 40 – Patient Input Connector Board (5-Lead)



NOTE: Requires Label Kit (Item 65)

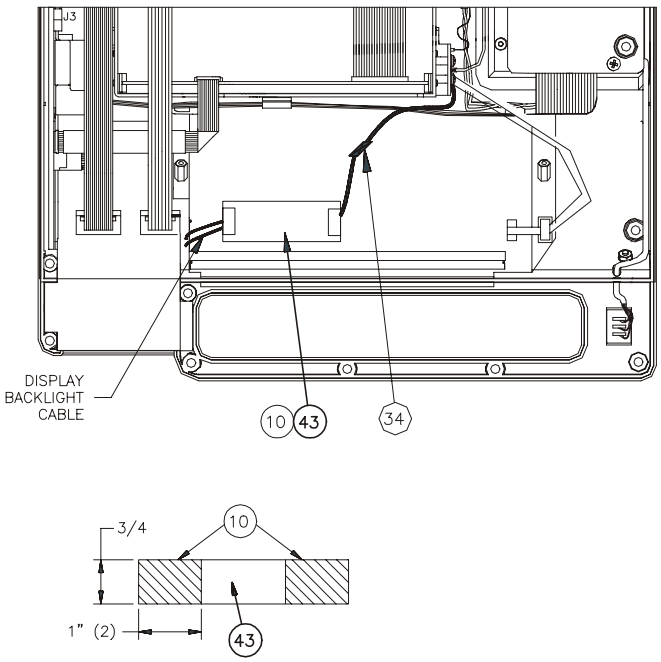
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Paddle Preamp Shield (Item 29).
4. Remove Paddle Preamp Board (Item 27).
5. Remove Patient Input Bracket (Item 39).
6. Insert Patient Input Connector Tool (Item 127) into ECG Patient Cable Connector with the key at the top of the unit.
7. Push in and slightly press down until a click is heard and Patient Input Connector Board (Item 40) loosens.
8. Remove Patient Input Connector (Item 40), O-ring (Item 60), and ECG Label (Item 59) from the unit.

REPLACE

1. Place Patient Input Connector (Item 40) in the unit so that it fits through the hole.
2. Insert Patient Input Connector Tool (Item 127) into ECG Patient Cable Connector with the key at the top of the unit.
3. Push in and slightly up until a click is heard and Patient Input Connector Board (Item 40) fits into place.
4. Place O-ring (Item 60) around Patient Input Connector Board (Item 40) on the outside of the unit.
5. Attach the ECG Label (Item 59) on the outside of the unit.
6. Replace Patient Input Bracket (Item 39).
7. Replace Paddle Preamp Board (Item 27).
8. Replace Paddle Preamp Shield (Item 29).
9. Replace Card Cage Pre-Assembly (Item 48).
10. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
11. Replace Bottom Enclosure (Item 21).

Item 43 – Backlight Inverter



NOTE: Requires foam tape (Item 10) from Fastener Kit (Item 16).

REMOVE

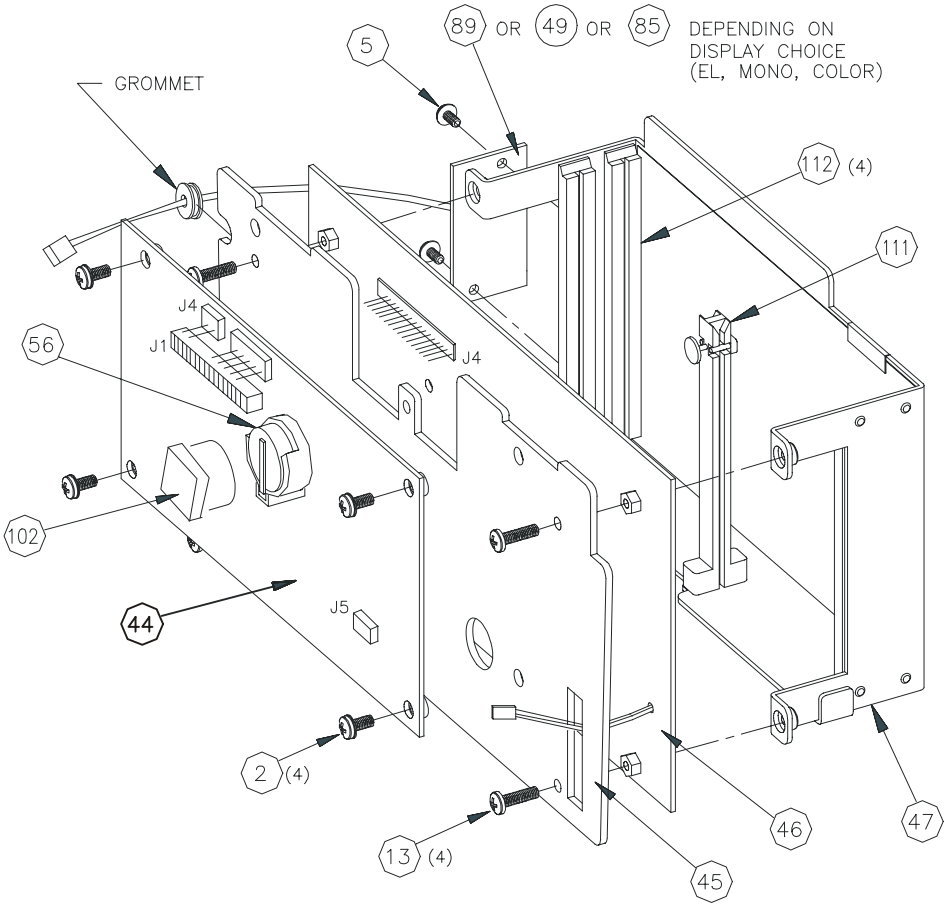
1. Remove Bottom Enclosure (Item 21).
2. Disconnect LCD Inverter Cable (Item 34) from Backlight Inverter (Item 43) at CN1 by pulling wires out of the connector.
3. Disconnect Display Backlight Cable from Backlight Inverter (Item 43) at CN2 by pulling the cable out from the connector.
4. Use a flat blade to remove the double-sided foam tape (Item 10) off the unit.

REPLACE

1. Secure Backlight Inverter (Item 43) to Top Enclosure Assembly (Item 22) using double-sided foam tape (Item 10).
2. Connect LCD Inverter Cable (Item 34) to Backlight Inverter (Item 43) at CN1 by pushing on the connector; the ridged side of the cable should face out.
3. Connect Display Backlight Cable from Backlight Inverter (Item 43) at CN2 by pushing on the connector. The red and green dots should face out.
4. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

NOTE: Be careful not to flex the Backlight Inverter (Item 43) when installing. Press gently on Item 43 directly over tape.

Item 44 – Power Supply Board



CAUTION: ***Performing this operation will cause loss of PIC variable settings to factory defaults! The preferred settings must be restored prior to returning the PIC to use.***

REMOVE

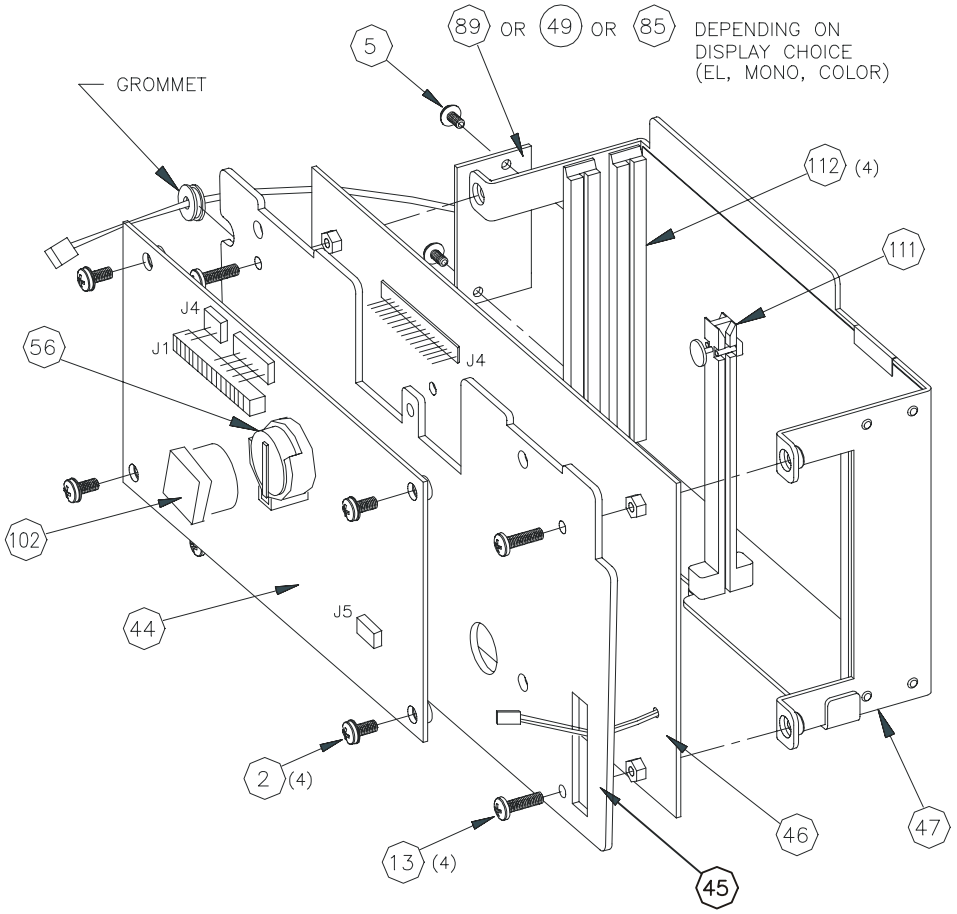
1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Defib Main Cable (Item 19).
4. Disconnect Display Adapter Supply Cable from Power Supply Board (Item 44) at J4 by pulling on the connector.
5. Disconnect Chart Power Cable from Power Supply Board (Item 44) at J5 by pulling on the connector.

6. Remove four screws (Item 2) from Power Supply Board (Item 44) using #2 Phillips head screwdriver.
7. Remove the Power Supply Board (Item 44) from the Card Cage Pre-Assembly (Item 48).

REPLACE

1. Place Power Supply Board (Item 44) onto Card Cage Pre-Assembly (Item 48) with J5, Chart Power Cable connector, near Chart Power Cable and line up the screw holes. Make sure that all 16 pins of Motherboard (Item 46) are inserted into Power Supply Board (Item 44).
2. Replace the four screws (Item 2) to the Power Supply Board (Item 44) using a #2 Phillips head screwdriver. Use 5/16" screws (Item 2).
3. Connect LCD Display Adapter Cable to Power Supply Board (Item 44) at J4 by pushing on the connector. Lip on female connector should go under holder on male connector.
4. Replace Defib Main Cable (Item 19).
5. Replace Card Cage Pre-Assembly (Item 48).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 45 – Card Cage Plate



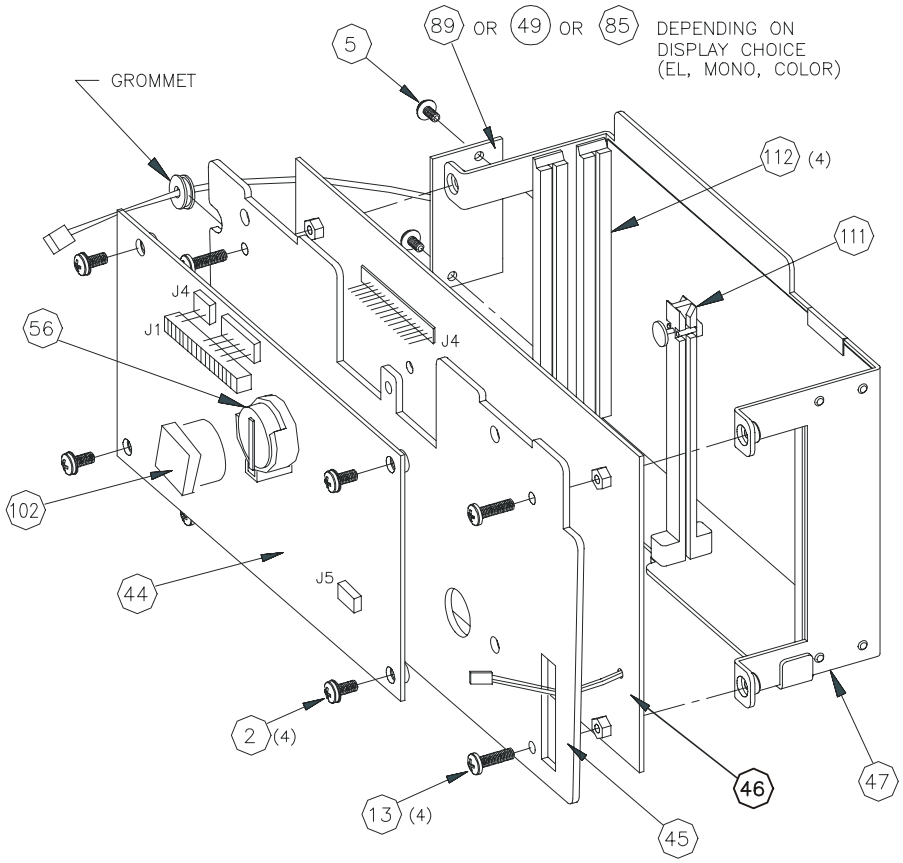
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Defib Main Cable (Item 19).
4. Remove Power Supply Board (Item 44).
5. Remove four screws (Item 13) from Card Cage Plate (Item 45) using #2 Phillips head screwdriver.
6. Lift Card Cage Plate (Item 45).

REPLACE

1. Feed Chart Power Cable through hole in the Card Cage Plate (Item 45).
2. Place Card Cage Plate (Item 45) onto Motherboard (Item 46) and align the screw holes.
3. Replace four screws (Item 13) to the Card Cage Plate (Item 45) using a #2 Phillips head screwdriver. Use ½" screws (Item 13).
4. Replace Power Supply Board (Item 44). Use 5/16" screws (Item 2).
5. Replace Defib Main Cable (Item 19).
6. Replace Card Cage Pre-Assembly (Item 48).
7. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
8. Replace Bottom Enclosure (Item 21).

Item 46 – Motherboard



CAUTION: Performing this operation will cause loss of PIC variable settings to factory defaults! The preferred settings must be restored prior to returning the PIC for use. Purchased options will also be lost.

NOTE: Re-order part number598329 for PIC, PIC 2, PIC 2H, and PIC Monitor. Order 599329 for MRL Lite. The new Mother Board will come pre-programmed with a unique serial number. Contact factory to obtain upgrde codes.

REMOVE

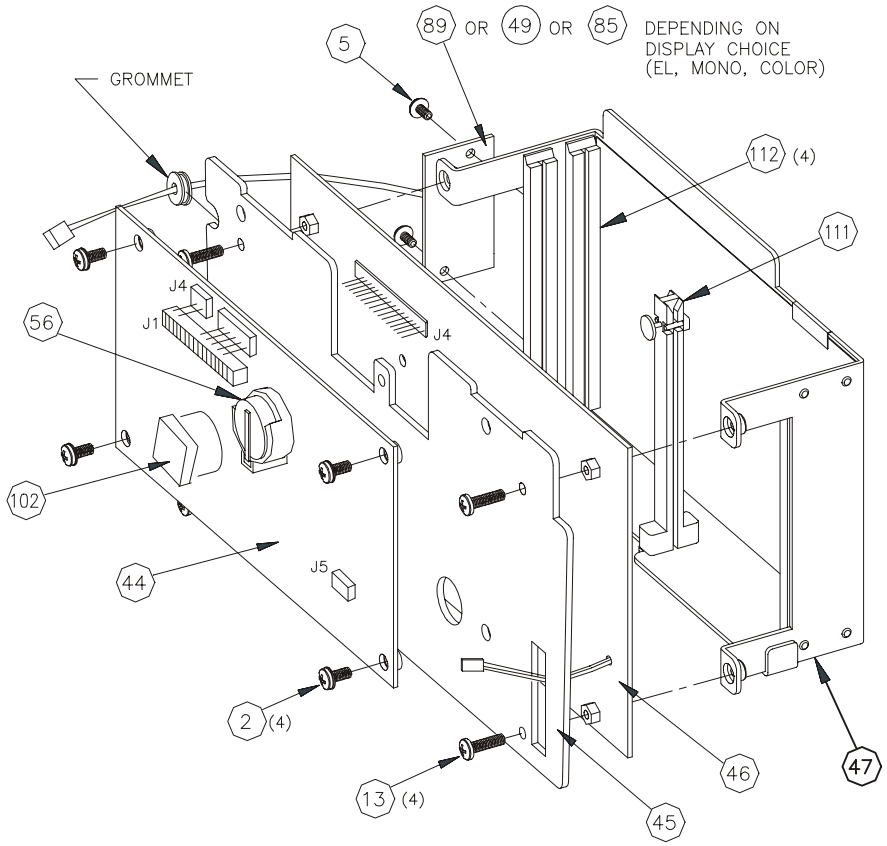
1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Defib Main Cable (Item 19).
4. Remove Power Supply Board (Item 44).
5. Disconnect Preamp-Motherboard Cable (Item 52) from Motherboard (Item 46) at J217 by pulling on the cable or 12-Lead Motherboard Cable (Item 82) at J104.

6. Disconnect Flat Panel Display Cable (Item 50) from Motherboard (Item 46) at J220 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
7. Disconnect Main Blood Pressure Cable (Item 93).
8. Remove Speech Board (Item 94).
9. Disconnect Main Oximeter Cable (Item 91) if option installed.
10. Remove Card Cage Plate (Item 45).
11. Lift Motherboard (Item 46) off of Card Cage Bracket (Item 47).

REPLACE

1. Place Motherboard (Item 46) onto Card Cage Bracket (Item 47) with Power Supply pins up and line up the screw holes.
2. Replace Card Cage Plate (Item 45). Use 1/2" screws (Item 13). Replace Speech Board (Item 94).
3. Connect Flat Panel Display Cable (Item 50) to Motherboard (Item 46) at J220 by lifting retaining clip with fingernail or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should be facing the outside of Card Cage Pre-Assembly (Item 48).
4. Connect Preamp-Motherboard Cable (Item 52) to Motherboard (Item 46) at J217 by pushing cable into connector; the blue side of the cable should be facing the Motherboard (Item 46) or the 12-Lead Motherboard (Item 82) at J104, insulated side should face bottom of unit.
5. Replace Power Supply Board (Item 44). Use 5/16" screws (Item 2).
6. Replace Defib Main Cable (Item 19).
7. Replace Card Cage Pre-Assembly (Item 48).
8. Connect Main Blood Pressure Cable (Item 93) and Main Oximeter Cable (Item 91).
9. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
10. Replace Bottom Enclosure (Item 21).
11. Restore purchased options as outlined in the Supervisor Setup section of Chapter 3.

Item 47 – Card Cage Bracket



REMOVE

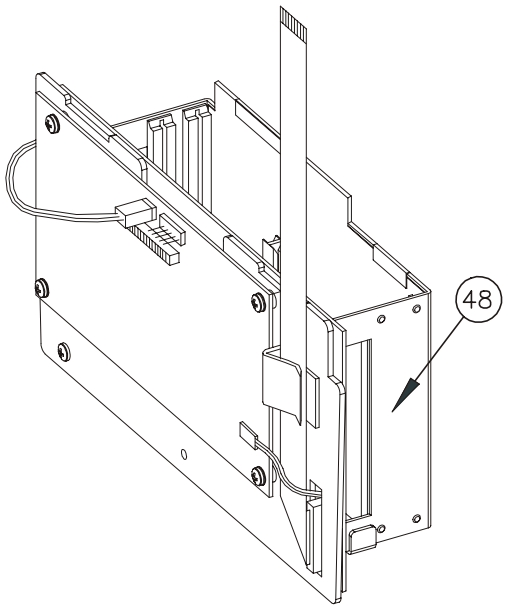
1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Defib Main Cable (Item 19).
4. Remove Power Supply Board (Item 44).
5. Remove Card Cage Plate (Item 45).
6. Remove Motherboard (Item 46).

REPLACE

1. Replace the Motherboard (Item 46).
2. Replace Card Cage Plate (Item 45). Use 6-32 x 1/2" screws (Item 13).
3. Replace Power Supply Board (Item 44). Use 6-32 x 5/16" screws (Item 2).

4. Replace Defib Main Cable (Item 19).
5. Replace Card Cage Pre-Assembly (Item 48).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 48 – Card Cage Pre-Assembly



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Preamp Input Cable (Item 32) from Paddle Preamp Board (Item 27) at J2 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable. If 12-Lead unit, disconnect 12-Lead Preamp Protection Cable (Item 81) at J2 on 12-Lead Preamp Board (Item 84).
3. Disconnect Paddle Pickup Cable (Item 97) at J1 of 12-Lead preamp Board (Item 84) by carefully pulling out connector.
4. Disconnect Front Panel Cable (Item 31) from Motherboard (Item 46) at J108 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
5. Disconnect Pacer Panel Cable (Item 30) from Motherboard (Item 46) at J211 by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
6. Disconnect Temperature Cable (Item 75) at J2 on blood pressure board and J3 on Oximeter board (Item 90) by pulling on connectors (Item 92). Disconnect small hose from valve coming from Blood Pressure board (Item 92). Disconnect AP Pump Valve cable at J5 on Blood Pressure Board (Item 92) by pulling on connectors.
7. Disconnect Mono LCD Inverter Cable (Item 34) from Mono

LCD Display Adapter Board (Item 49) at J4 by pulling on the connector.

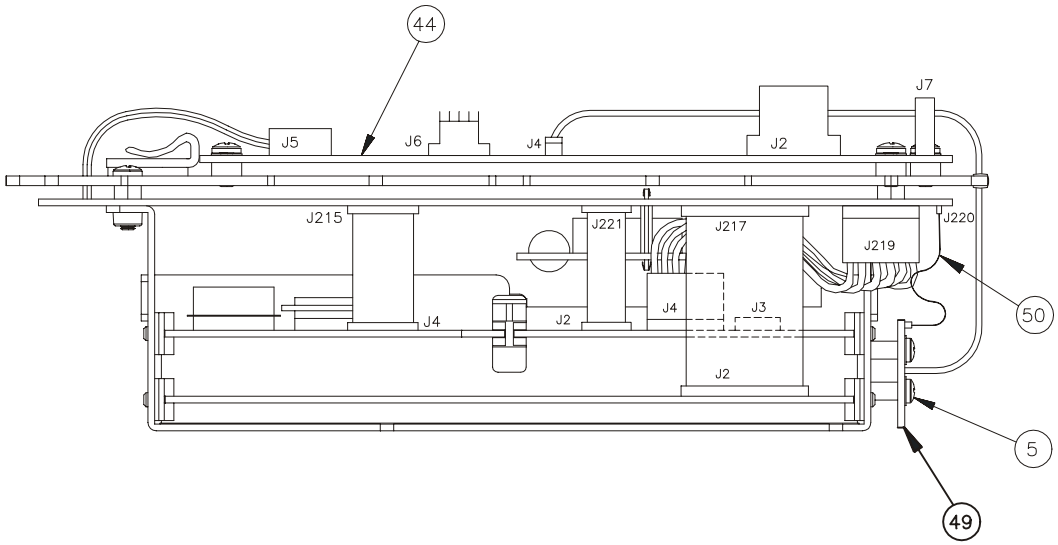
8. For color option, disconnect Color Display Cable (Item 108) at J3 on Color Display Adapter Board (Item 85) by lifting up on connector. Disconnect Color Inverter Cable (Item 109) at J2 on Color Display Adapter Board (Item 85) by pulling connector out.
9. For EL option, disconnect EL Display Cable (Item 71) at J2 on EL Display Adapter Board (Item 89) by lifting connector up.
10. Disconnect Mono LCD Cable (Item 35) from LCD Display Adapter Board (Item 49) at J5 by very carefully lifting retaining clip with fingernails or small instrument and carefully pulling out cable. (The Connector is fragile.)
11. Disconnect Speaker Cable from Motherboard (Item 46) at J105 by carefully pulling on connector.
12. Disconnect Defib Power Cable from Power Supply Board (Item 44) at J7 by pushing down on locking mechanism and pulling out.
13. Disconnect Power Supply Cable on Battery Board (Item 54) from Power Supply board (Item 44) at J2 by pushing down on locking mechanism and pulling out.
14. Disconnect Power Switch Cable (Item 5) from Power Supply Board (Item 44) at J6 by carefully pulling on connector; if metal pins become bent, straighten them.
15. Lift Defibrillator Module (Item 23) on the side where J8 is located, disconnect Defib Main Cable (Item 19) from Defibrillator Module (Item 23) at J8 by carefully pulling out cable.
16. Disconnect Pad Pickup Cable from Paddle Preamp Board (Item 27) at J1 by carefully pulling on cable.
17. Clear all cables and slowly slide Card Cage Pre-Assembly (Item 48) up along the rails.
18. Disconnect Chart Recorder Cable (Item 53) from Motherboard (Item 46) at J114 by pressing side eject levers in and pulling out cable; slide cable out from wire holder on the back of Card Cage Pre-Assembly (Item 48). If installed, disconnect Memory Card Cable (Item 15) from Motherboard at J207.

REPLACE

1. Clear all cables from center of unit.
2. Connect Chart Recorder Cable (Item 53) to Motherboard (Item 46) at J114 by lining up white arrows and pushing until a "click" is heard; slide cable into wire holder on the back of Card Cage Pre-Assembly (Item 48). Connect Memory Card Cable (Item 15) at J207 on Motherboard, if option installed.
3. Push the Grommet of Display Adapter Power Supply Cable into the hole in Card Cage Pre-Assembly (Item 48) near Speaker Cable connection at J105 on Motherboard (Item 46).
4. Carefully slide Card Cage Pre-Assembly (Item 46) into the unit on the 2 rails. Card Cage Pre-Assembly (Item 48) should slide in easily without resistance. Paddle Preamp Board (Item 27) may need to be pushed against the wall, or the red battery cap of 3V coin-cell Battery case (Item 56) on Power Supply Board (Item 44) may need to be pushed down.
5. Push Display Adapter Power Supply Cable into the space between Battery and Chart Recorder housing.
6. Connect Power Switch Cable to Power Supply Board (Item 44) at J6 by carefully pushing on connector. Lip on female connector should go under hole on male connector.
7. Connect Power Supply Cable on Battery Board (Item 54) to Power Supply Board (Item 44) at J2 by pushing down on locking mechanism and pushing in.
8. Connect Defib Power Cable to Power Supply Board (Item 44) at J7 by pushing down on locking mechanism and pushing in.
9. Push down all 3 previous cables into the unit.
10. Lift Defibrillator Module (Item 23) on the side where J8 is located; connect Defib Main Cable (Item 19) to Defibrillator Module (Item 23) at J8 by carefully pushing in cable, making sure it is seated straight. The blue side of the cable should face the wall of the unit.
11. Press Defibrillator Module (Item 23) into the unit so that is seated correctly.
12. Feed Pad Pickup Cable under Defib Main Cable (Item 19) and connect Paddle Pickup Cable to Paddle Preamp Board (Item 27) at J1 by carefully pushing onto connector. Lip on female connector should go under holder on male connector.
13. Connect Speaker Cable to Motherboard (Item 46) at J105 by carefully pushing on connector. Lip on female connector should go under holder on male connector.

14. For EL Display, connect EL Display Cable (Item 71) at J2 on EL Display Adapter Board (Item 89) by pushing connector into the matching notches. For Color option, connect Color Display Adapter Board (Item 85).
15. Connect Mono LCD Cable (Item 35) to LCD Display Adapter Board (Item 49) at J5 by very carefully lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that the cable is seated straight, and pushing down on retaining clip; the white side of the cable should face the back of the retaining clip. (Connector is fragile)
16. Connect Mono LCD Inverter Cable (Item 34) to Mono LCD Display Adapter Board (Item 49) at J4 by pushing on connector; the ridged side of the cable should face out.
17. Connect Front Panel Cable (Item 31) to Motherboard (Item 46) at J108 by lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should face the back of the retaining clip.
18. Connect Pacer Panel Cable (Item 30) to Motherboard (Item 46) at J211 by lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should face the back of the retaining clip.
19. Connect Blood Pressure Pump Valve Cable at J5 of Blood Pressure Board (Item 92) by pushing connector on to metal pins. Connect Temperature Cables (Item 75) at J2 on Blood Pressure Board (Item 92) (lighter gray wire with 5 pin connector) and J3 on Oximeter Board (Item 90) (darker gray wire with 7 pin connector). Securely fasten small hose to valve assembly on blood pressure board.
20. Connect Preamp Input Cable (Item 32) to Paddle Preamp Board (Item 27) at J2 by lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should face the back of the retaining clip.
21. If 12-Lead unit, connect Paddle Pickup Cable (Item 97) at J1 on 12-Lead Preamp Board (Item 84). Connect 12-Lead Preamp Protection Cable (Item 81) at J2 on 12-Lead Preamp Board (Item 84) by pushing in cable; insulated side of cable should face 12-Lead Preamp Board.
22. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
23. Replace Bottom Enclosure (Item 21).

Item 49 – LCD Display Adapter Board



NOTE: If the display (Item 42) has two white wires connected to the Backlight Inverter (Item 43), use Part Number 591382 for Item 49. If two white and pink wires are connected to the Backlight Inverter (Item 43) use Part Number 590382 for Item 49.

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect Display Power Supply Cable from Power Supply Board (Item 44) at J4 by pulling on the connector.
4. Disconnect Flat Panel Display Cable (Item 50) from LCD Display Adapter Board (Item 49) at J1 by lifting retaining clip with fingernail or a small instrument and pulling out cable. Disconnect Mono LCD Cable (Item 35) from J5.
5. Remove two screws (Item 5) from LCD Display Adapter Board (Item 49) using a #1 Phillips head screwdriver.
6. Lift LCD Display Adapter Board (Item 49) off of Card Cage Pre-Assembly (Item 48).

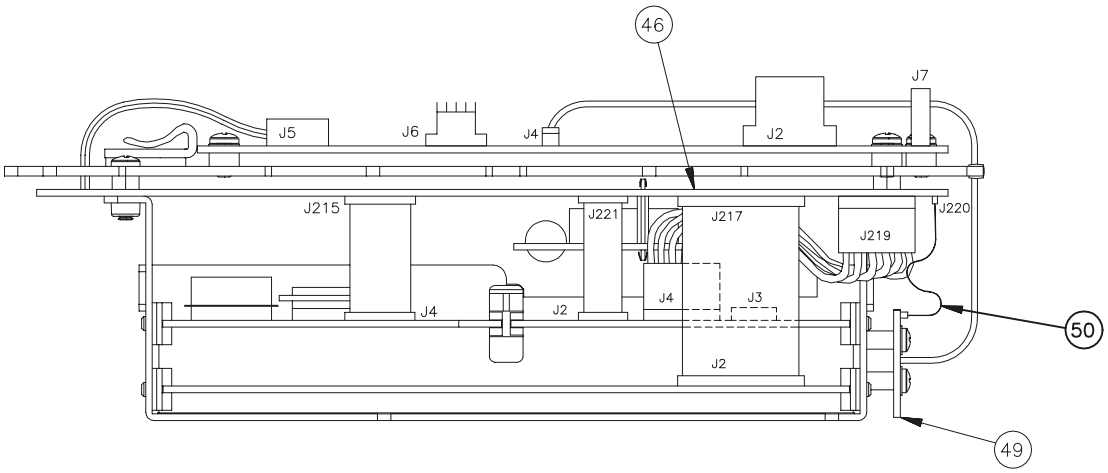
REPLACE

1. Position LCD Display Adapter Board (Item 49) on the side

of the Card Cage Pre-Assembly (Item 48) so that J1 is near Motherboard (Item 46).

2. Replace the two screws (Item 5) to the LCD Display Adapter Board (Item 49) using a #1 Phillips head screwdriver.
3. Connect Flat Panel Display Cable (Item 50) to LCD Display Adapter Board (Item 49) at J1 by lifting retaining clip with fingernail or a small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should face Motherboard (Item 46). Connect Mono LCD Cable (Item 35) to J5.
4. Connect Display Power Supply Cable to Power Supply Board (Item 44) at J4 by pushing on connector. Lip of female connector should go under holder on male connector.
5. Replace Card Cage Pre-Assembly (Item 48).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 50 – Flat Panel Display Cable



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect Flat Panel Display Cable (Item 50) from LCD Display Adapter Board (Item 49) at J1 (or from Color Display Adapter Board (Item 85) at J4 and from EL Display Adapter Board (Item 89) at J1) by lifting retaining clip with fingernail or a small instrument and pulling out cable.
4. Disconnect Flat Panel Display Cable (Item 50) from the Motherboard (Item 46) at J220 by lifting retaining clip with fingernail or a small instrument and pulling out cable.

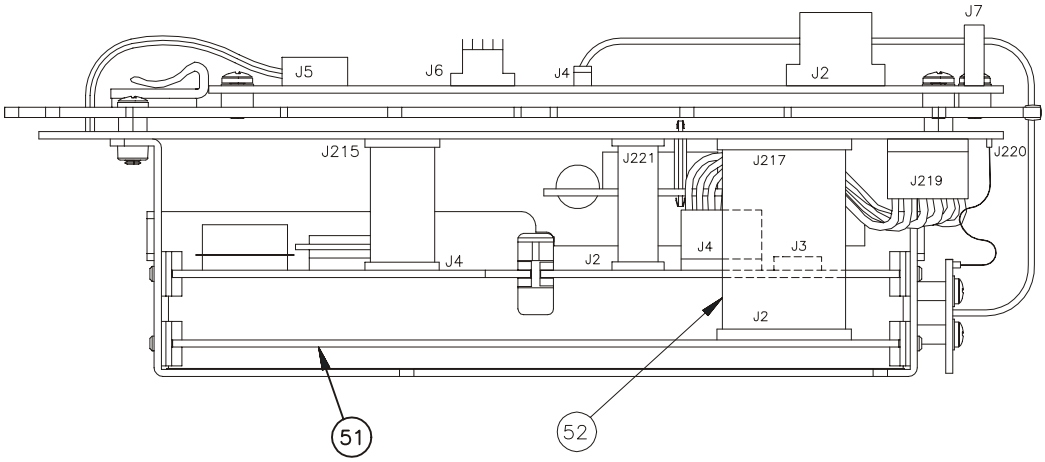
REPLACE

1. Connect Flat Panel Display Cable (Item 50) to Motherboard (Item 46) at J220 by lifting retaining clip with fingernail or a small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the blue side of the cable should be facing the outside of Card Cage Pre-Assembly (Item 48).
2. Connect Flat Panel Display Cable (Item 50) to LCD Display Adapter Board (Item 49) at J1 (or to Color Display Adapter Board (Item 85) at J4 and to EL Display Adapter Board (Item 89) at J1) by lifting retaining clip with fingernail or a small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip. The blue

side of the cable should face the outside of the Motherboard (Item 46).

3. Replace Card Cage Pre-Assembly (Item 48).
4. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 51 – ECG Preamp Board (5-Lead)



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Preamp Input Cable (Item 32) from ECG Preamp Board (Item 51) at J3 by pulling on cable.
3. Disconnect Preamp-Motherboard Cable (Item 52) from ECG Preamp Board (Item 51) at J2 by pulling on cable.
4. Lift ECG Preamp Board (Item 51) out of the unit by the white handle.

NOTE: Hold card cage down when pulling preamp board out of card cage.

WARNING: DO NOT touch preamp board with fingers or tools because of contamination and ESD.

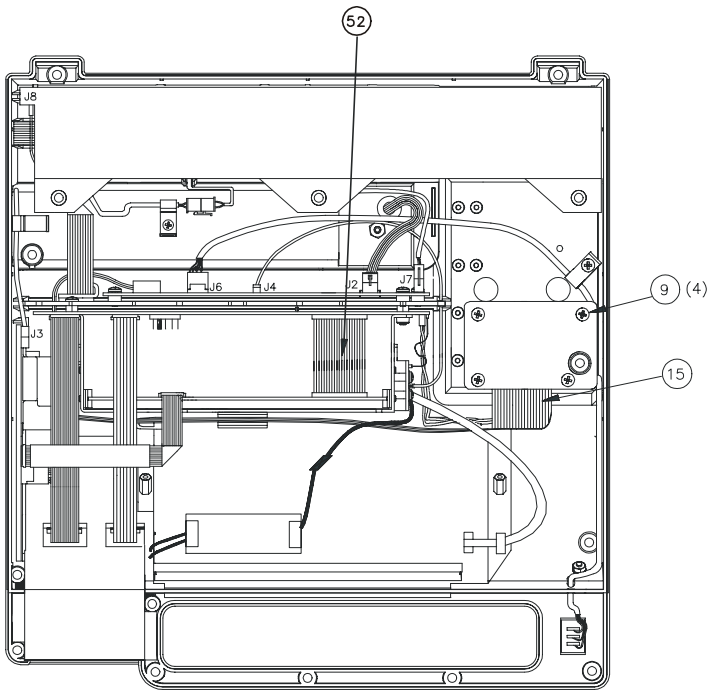
REPLACE

1. Carefully slide ECG Preamp Board (Item 51) into Card Cage Pre-Assembly (Item 48) along two rails making sure that the handle faces Motherboard. Push in until movement stops and ECG Preamp Board (Item 51) is flush with Card Cage Pre-Assembly.
2. Connect Preamp-Motherboard Cable (Item 52) to ECG Preamp Board (Item 51) at J2 by pushing in cable; the blue side of the cable should be face ECG Preamp Board.
3. Connect Preamp Input Cable (Item 32) to ECG Preamp Board (Item 51) at J3 by pushing in cable; the blue side of the cable should face the inside of the Card Cage

Pre-Assembly.

4. Check that all cables are seated correctly and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 52 – Preamp-Motherboard Cable (5-Lead)



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Preamp-Motherboard Cable (Item 52) from ECG Preamp Board (Item 51) at J2 by pulling on cable.

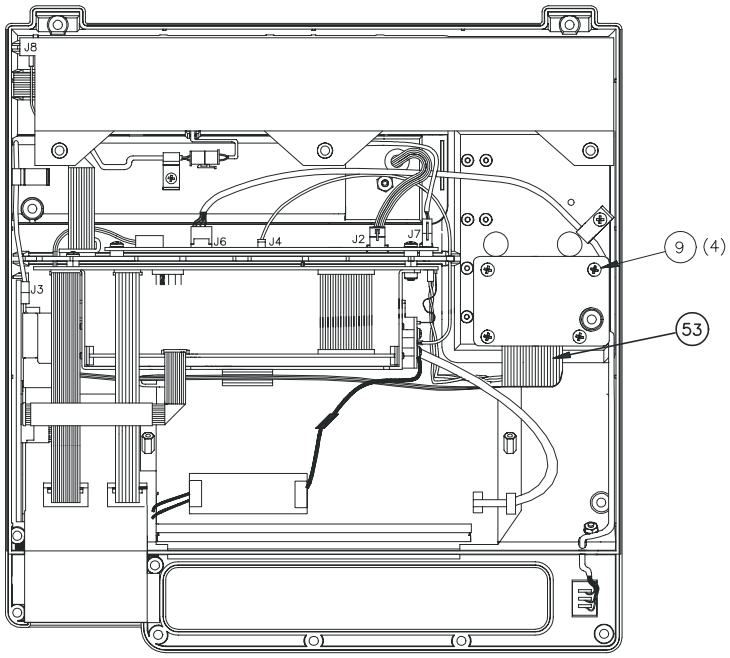
WARNING: DO NOT touch preamp board with fingers or tools because of contamination and ESD.

3. Disconnect Preamp-Motherboard Cable (Item 52) from Motherboard (Item 46) at J217 by pulling on cable.

REPLACE

1. Connect Preamp-Motherboard Cable (Item 52) to Motherboard (Item 46) at J217 by pushing cable into connector; the blue side of the cable should be facing Motherboard.
2. Connect Preamp-Motherboard Cable (Item 52) to ECG Preamp Board (Item 51) at J2 by pushing in cable; the blue side of the cable should be face ECG Preamp Board.
3. Check that all cables are seated correctly and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 53 – Chart Recorder Cable



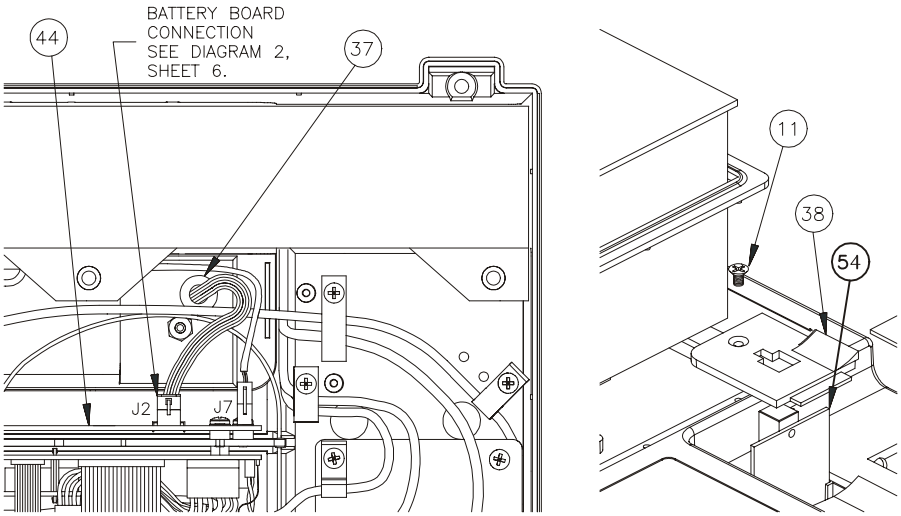
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove four screws (Item 9) from gold bracket covering Chart Recorder Cable (Item 53) with a #2 Phillips head screwdriver.
4. Remove Chart Recorder Cable (Item 53) by rocking it back and forth while pulling out. May require some force.

REPLACE

1. Insert Chart Recorder Cable (Item 53) into Chart Recorder housing. Make sure that the cable is correctly seated in the connector.
2. Replace four screws (Item 9) in gold bracket attached to Chart Recorder Cable (Item 53) with a #2 Phillips head screwdriver.
3. Replace Card Cage Pre-Assembly (Item 48).
4. Check that all cables are seated correctly and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 54 – Battery Board



NOTE: Requires Silicon RTV (Item 37).

REMOVE

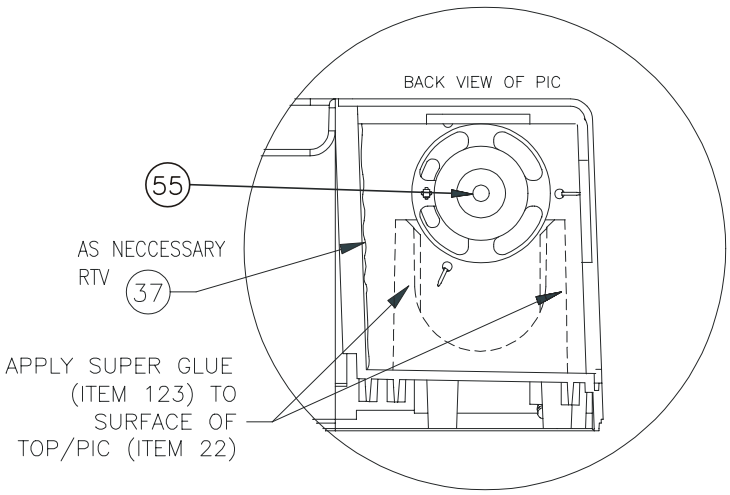
1. Remove AC Supply/Paddle Tray Module (Item 17) if present.
2. Remove Bottom Enclosure (Item 21).
3. Disconnect Power Supply Cable on Battery Board from Power Supply Board (Item 44) at J2 by pushing down on locking mechanism and pulling out.
4. Remove wire terminals from connector J6 or cut wires to remove connector.
5. Remove Silicon RTV from wire hole.
6. Remove Battery Board Cover (Item 38).
7. Slide Battery Board (Item 54) from the unit.

REPLACE

1. Wrap tape temporarily around the wires of Battery Board (Item 54) to allow easy entry into the wire hole in the back of the unit.
2. Slide Battery Board (Item 54) into the unit along the two rails. Make sure that all 5 wires pass through the wire hole into the back of the unit.

3. Replace Battery Board Cover (Item 38).
4. Remove tape from wires of Battery Board (Item 54).
5. Use Silicon RTV (Item 37) to seal the wire access hole around the wires.
6. Insert the appropriate wires into the connector J6 following Diagram 2 in Chapter 9.
7. Connect Power Supply Cable on Battery Board (Item 54) to Power Supply Board (Item 44) at J2 by pushing down on locking mechanism and pushing in.
8. Check that all cables are seated correctly and are clear of the sides of the unit.
9. Replace Bottom Enclosure (Item 21).
10. Replace AC Supply/Paddle Tray Module (Item 17) if present.

Item 55 – Speaker Assembly



NOTE: Requires Silicon RTV (Item 37) and Super Glue (Item 123).

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Speaker Cable from Motherboard (Item 46) at J105 by carefully pulling on connector.
3. Remove four screws (Item 9) from bracket covering Chart Recorder Cable (Item 53) with a #2 Phillips head screwdriver.
4. Remove Chart Recorder Cable (Item 53) by rocking it back and forth while pulling out. May require some force.
5. Remove Silicon RTV from around Speaker cable.
6. Remove Chart Recorder (Item 36)
7. Remove Chart Recorder Cover (Item 20).
8. Remove Silicon RTV from around Speaker Assembly (Item 55).
9. Remove Speaker Assembly (Item 55) from the unit.

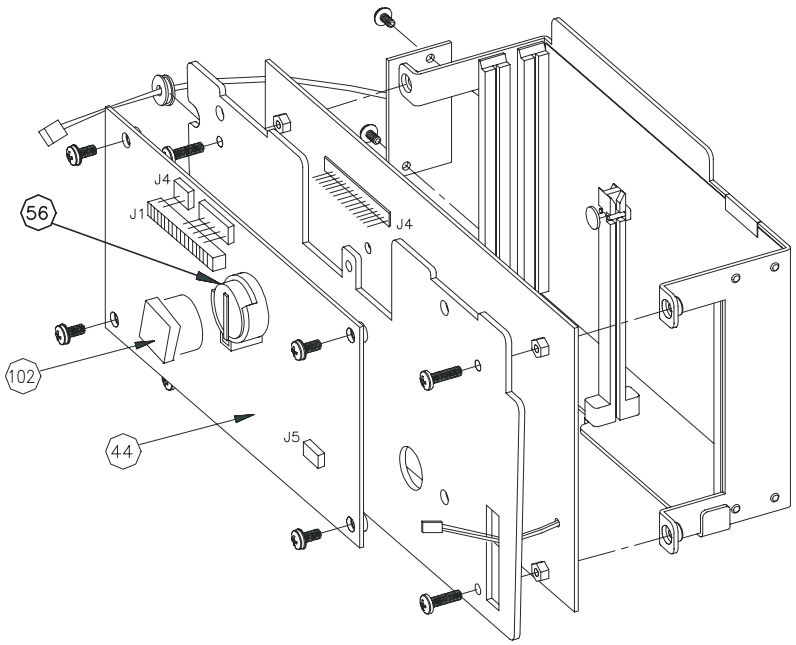
REPLACE

1. Feed Speaker Cable into the hole in the Chart Recorder housing.
2. Attach connector body to wires using Super Glue.
3. Place Speaker Assembly (Item 55), with Speaker toward

the top of the unit, in between the Chart Recorder Seal (Item 7) and the plastic housing.

4. Seal the Speaker Assembly (Item 55) into place using Silicon RTV (Item 37).
5. Seal the Speaker Cable into place using Silicon RTV (Item 37) on both sides of the hole. Check that there is enough length of Speaker cable in the unit to reach J105 on Motherboard (Item 46).
6. Replace the Chart Recorder Cover (Item 20).
7. Replace the Chart Recorder (Item 36).
8. Insert Chart Recorder Cable into Chart Recorder housing. Make sure that cable is correctly seated in the connector.
9. Replace four screws (Item 9) to bracket attached to Chart Recorder Cable (Item 53) with a #2 Phillips head screwdriver.
10. Connect Speaker Cable to Motherboard (Item 46) at J105 by carefully pushing on connector. Lip on female connector should go under holder on male connector.
11. Check that all cables are seated correctly and are clear of the sides of the unit.
12. Replace Bottom Enclosure (Item 21).

Item 56 – 3V Coin-Cell Battery



CAUTION: Performing this operation will cause loss of PIC variable settings to factory defaults! The preferred settings must be restored prior to returning the PIC for use.

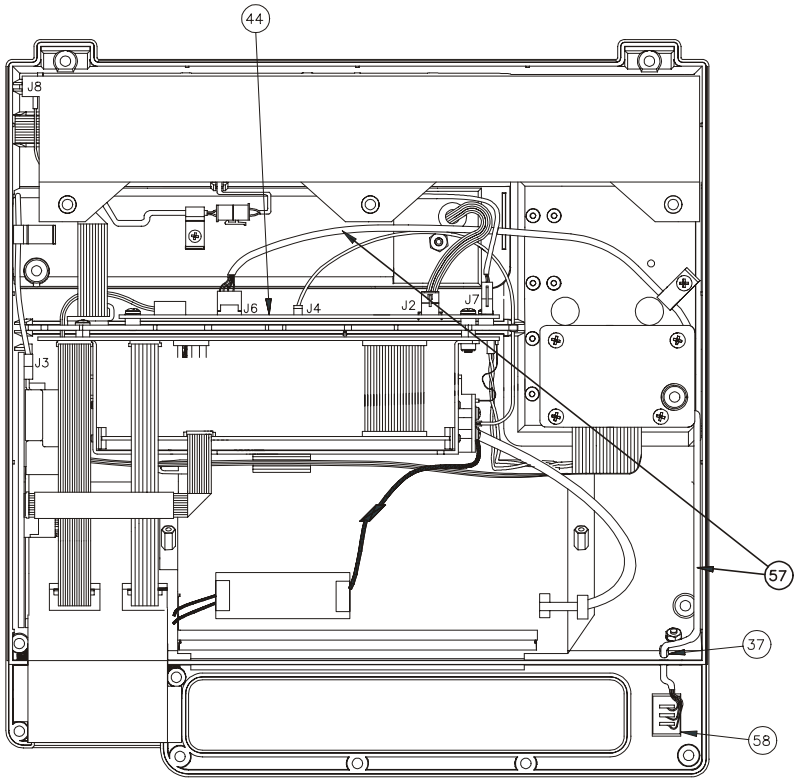
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Remove Red Cap (Item 102) off of 3V Coin-Cell Battery case located on the Power Supply Board (Item 44) at BT1.
4. Lift metal holder and remove 3V Coin-Cell Battery (Item 56).

REPLACE

1. Insert 3V Coin-Cell Battery (Item 56) under the metal holder in the 3V Coin-Cell Battery case on the Power Supply Board (Item 44) at BT1.
2. Replace Red Cap (Item 102) of 3V Coin-Cell Battery case.
3. Replace Card Cage Pre-Assembly (Item 48).
4. Check that all cables are seated correctly and are clear of the sides of the unit.
5. Replace bottom enclosure (Item 21).

Item 57 – Power Switch Cable



NOTE: Requires Silicon RTV (Item 37).

REMOVE

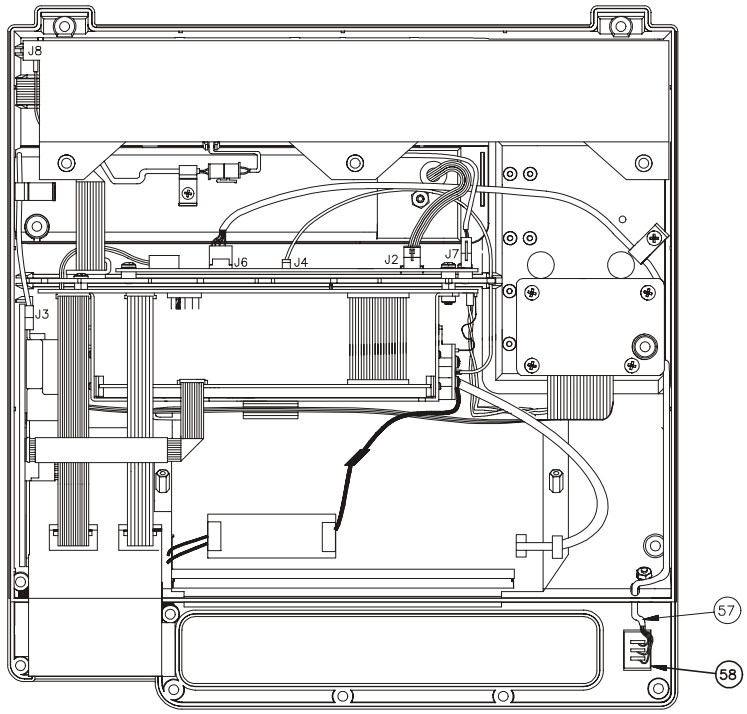
1. Remove Bottom Enclosure (Item 21).
2. Disconnect Power Switch Cable (Item 57) from Power Supply Board (Item 44) at J6 by carefully pulling on connector; if metal pins become bent, straighten them.
3. Unsolder three wires of Power Switch Cable (Item 57) from back of Power Switch (Item 58).
4. Remove Silicon RTV from cable hole in unit.
5. Pull Power Switch Cable (Item 57) out of unit while feeding through cable hole in unit.

REPLACE

1. Feed un-terminated end of Power Switch Cable through the cable hole near Power Switch (Item 58).

2. Solder three wires of Power Switch Cable (Item 57) to back of Power Switch (Item 58) as per Diagram 1 in Chapter 9.
3. Connect Power Switch Cable (Item 57) to Power Supply Board (Item 44) at J6 by carefully pushing on connector. Lip on female connector should go under holder on male connector.
4. Use Silicon RTV (Item 37) to seal the cable hole.
5. Check that all cables are seated correctly and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 58 – Power Switch



NOTE: Requires Label Kit (Item 26).

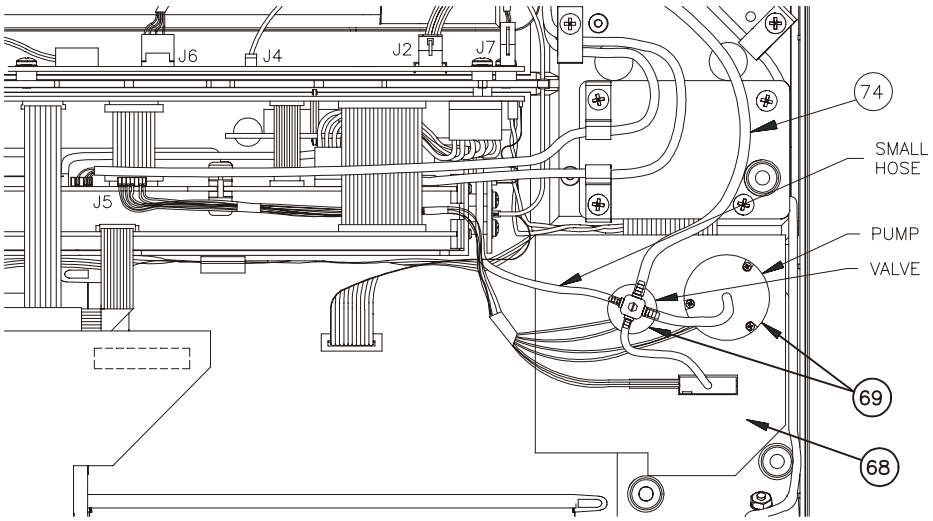
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Unsolder three wires of Power Switch Cable (Item 57) from back of Power Switch (Item 58).
3. Squeeze eject clips and push Power Switch (Item 58) through the front of the unit.
4. Remove the Power Switch Label (Item 26).

REPLACE

1. Push the Power Switch (Item 58) into the opening in the unit. Pin 1 should be at the front of the unit.
2. Solder three wires of Power Switch Cable (Item 57) to back of Power Switch (Item 58) as per Diagram 1 in Chapter 9.
3. Add Power Switch Label (Item 26) to front of unit.
4. Check that all cables are seated correctly and are clear of the sides of the unit.
5. Replace bottom enclosure (Item 21).

Item 68 & 69 – Blood Pressure Pump/Valve Assembly and Foam Block



REMOVE

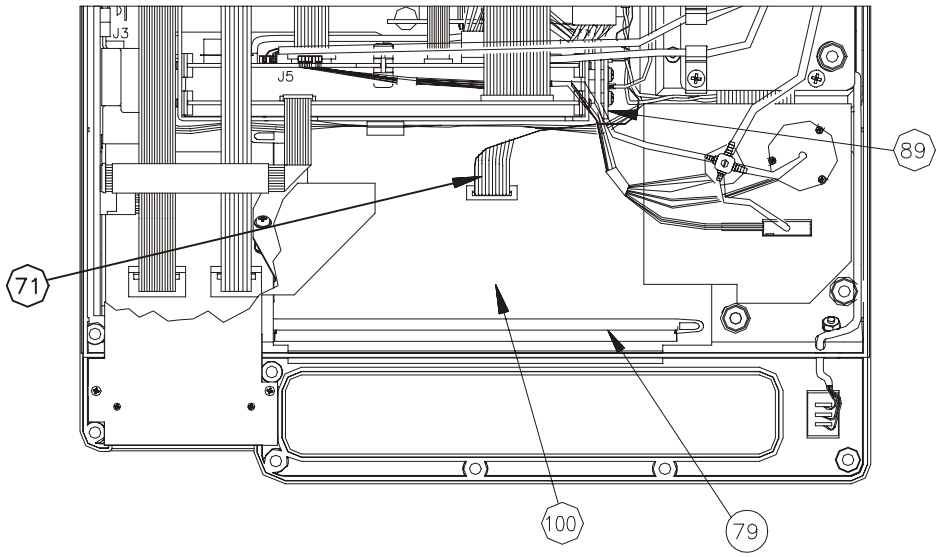
1. Remove Bottom Enclosure (Item 21).
2. Disconnect small hose from valve which runs from Blood Pressure Board (Item 92).
3. Disconnect the longer, larger Hose (Item 74) from the valve which runs from Blood Pressure Coupling (Item 73).
4. Disconnect Pump/Valve Cable at J5 of Blood Pressure Board (Item 92) by carefully pulling on connector.
5. Carefully lift Foam Block (Item 68) and Blood Pressure Pump/Valve Assembly (Item 69) together from unit.

REPLACE

1. Place Foam Block (Item 68) and Blood Pressure Pump/ Valve Assembly (Item 69), ensuring that the Foam Block sits correctly with the slanted side up against the front panel wall.
2. Connect cable at J5 of the Blood Pressure Board (Item 92) by pushing connector onto the metal pins.
3. Connect the longer, larger Hose (Item 74) to the valve at the nozzle counter-clockwise of the pump hose connection, ensuring that the Hose (Item 74) is securely connected to the nozzle.

4. Connect the small hose from the Blood Pressure Board (Item 92) to the valve at the nozzle clockwise of the hose sensor connection, ensuring that the hose is securely connected to the nozzle. Rotate the pump so the hose between the pump and valve is not crimped.
5. Check that all cable are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 71 – EL Display Cable



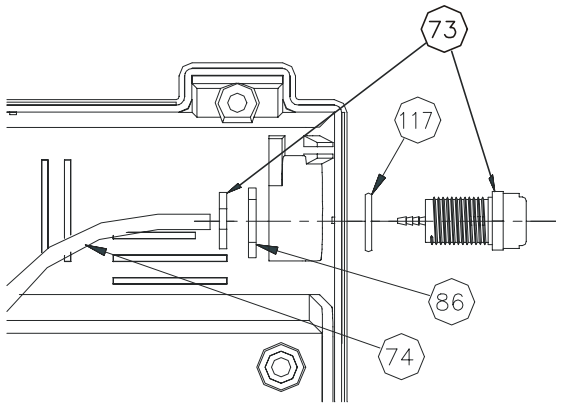
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect EL Display Cable (Item 71) at J1 of EL Display Adapter Board (Item 89).
3. Disconnect EL Display Cable (Item 71) at connector on back of EL Display (Item 79) by gently pulling on connector.

REPLACE

1. Connect EL Display Cable (Item 71) at J1 of EL Display Adapter Board (Item 89) by pushing connector into its slot, matching notches.
2. Connect EL Display Cable (Item 71) at J1 of EL Display Adapter Board (Item 89) by pushing connector into its slot, matching notches, ensure that the pin 1 indicator on the cable, a colored wire, matches the pin 1 indicator, a triangle, on the EL Display Adapter Board (Item 89).
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 73 – Blood Pressure Coupling



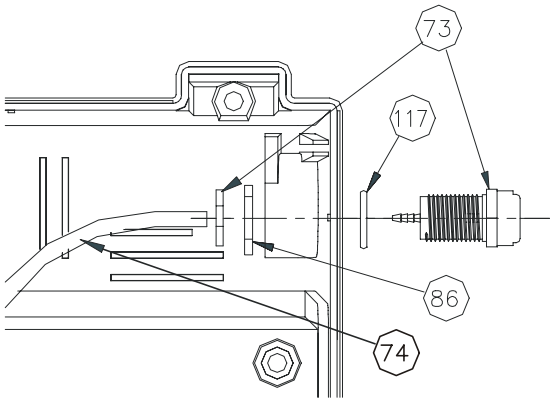
REMOVE

1. Remove bottom enclosure (Item 21).
2. Remove defibrillator assembly (Item 23).
3. Remove Tube (Item 74) from coupling (Item 73).
4. Remove nut and locking washer (Item 86).
5. Remove O-ring (Item 117) from coupling (Item 73).

REPLACE

1. Replace O-ring (Item 117).
2. Insert coupling (Item 73) into top enclosure.
3. Replace locking washer (Item 86) and nut.
4. Attach Tube (Item 74) to coupling.
5. Replace defibrillator assembly (Item 23).
6. Check that all cables are seated correctly and are clear of the sides of the unit.
7. Replace bottom enclosure (Item 21).

Item 74 – Blood Pressure Tube



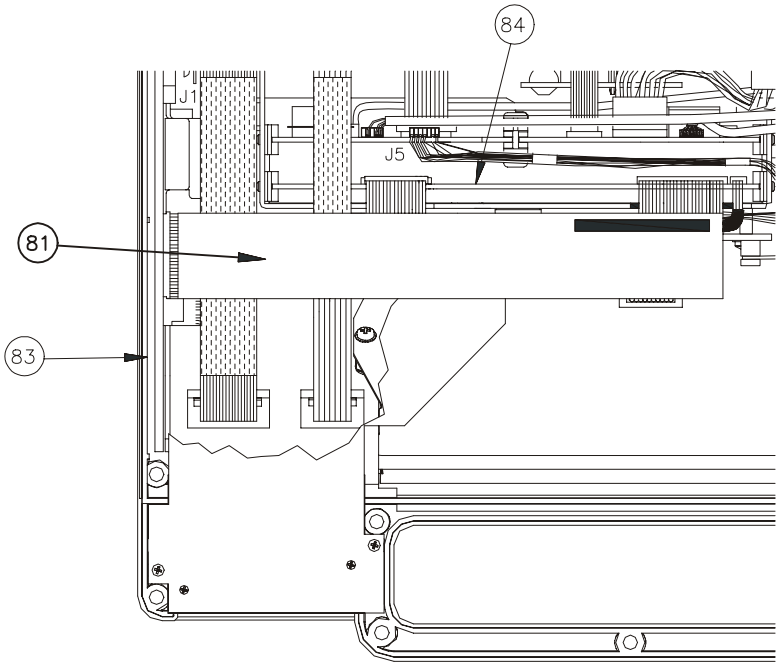
REMOVE

1. Remove bottom enclosure (Item 21).
2. Remove defibrillator assembly (Item 23).
3. Remove Tube (Item 74) from BP coupling (Item 73) and pump/valve assembly (Item 69).

REPLACE

1. Connect Tube (Item 74) to BP coupling (Item 73) and pump/valve assembly (Item 69). Long nose pliers may be necessary to properly seat the tube.
2. Replace defibrillator assembly (Item 23).
3. Check that all cables are seated correctly and are clear of the sides of the unit.
4. Replace bottom enclosure (Item 21).

Item 81 – 12-Lead Preamp-Protection Cable



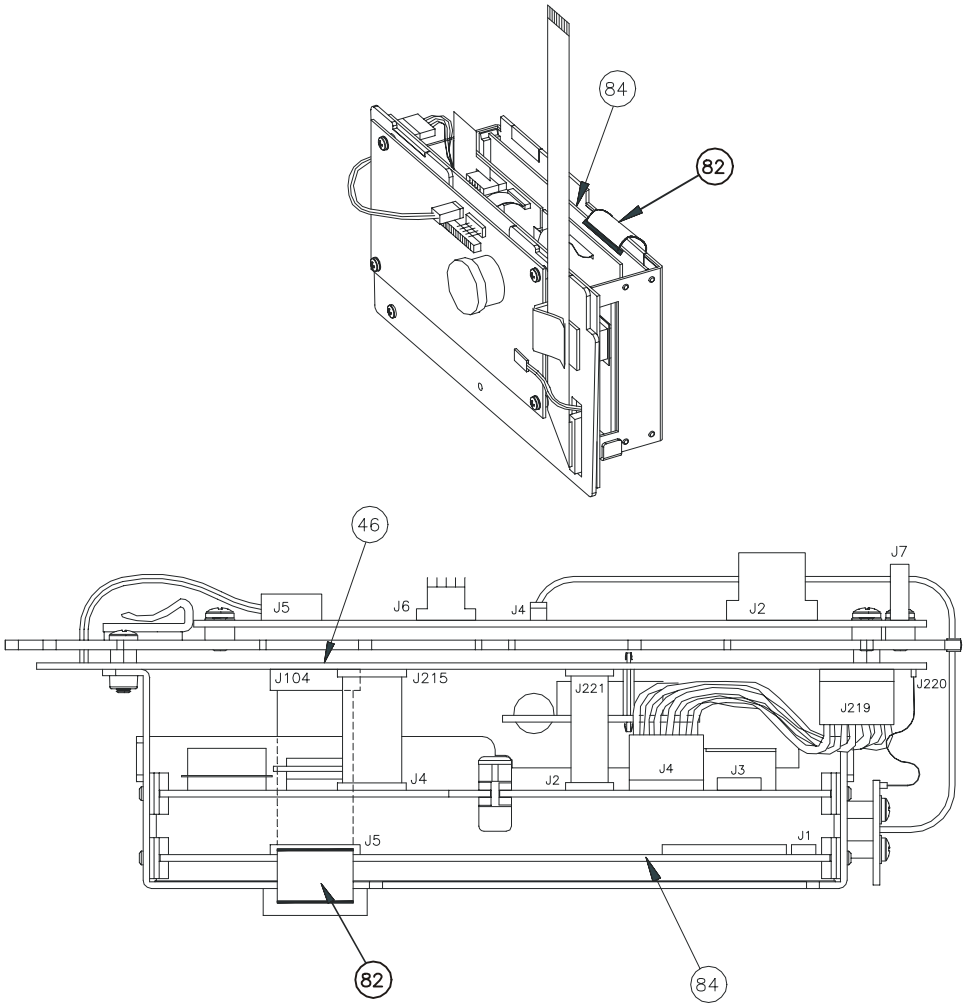
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect 12-Lead Preamp-Protection Cable (Item 81) at J2 of the 12-Lead Preamp Board (Item 84) by pulling on the cable.
3. Disconnect 12-Lead Preamp-Protection Cable (Item 81) at J3 of the 12-Lead Paddle Preamp board (Item 83) by pulling on the cable.

REPLACE

1. Connect 12-Lead Preamp-Protection Cable (Item 81) at J3 of the 12-Lead Paddle Preamp Board (Item 83) by pushing the cable into the connector; the insulated side of the cable should face up out of the unit.
2. Connect 12-Lead Preamp-Protection Cable (Item 81) at J2 of the 12-Lead Preamp Board (Item 84) by pushing the cable into the connector; the insulated side of the cable should face the 12-Lead Preamp Board (Item 84).
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 82 – 12-Lead Motherboard Cable



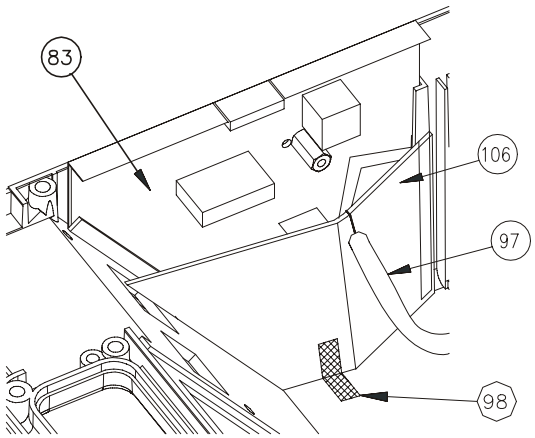
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect 12-Lead Motherboard Cable (Item 82) at J5 on 12-Lead Preamp Board (Item 84) by pulling on cable.
4. Disconnect 12-Lead Motherboard Cable (Item 82) at J104 on Motherboard (Item 46) by pulling on cable.

REPLACE

1. Connect 12-Lead Motherboard Cable (Item 82) at J104 on Motherboard (Item 46) by pushing cable into connector; the insulated side of the cable should face down into the unit.
2. Thread the Cable (Item 82) through the ferrite on the Card Cage and connect 12-Lead Motherboard Cable (Item 82) at J5 on 12-Lead Preamp Board (Item 84) by pushing cable into connector; the insulated side of the cable should face the 12-Lead Preamp Board.
3. Replace Card Cage Pre-Assembly (Item 48).
4. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 83 – 12-Lead Paddle Preamp Board



NOTE: Requires Conductive Tape (Item 98) and Adhesive Transfer Tape (Item 121) from Fastener Kit (Item 16).

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect 12-Lead Preamp-Protection Cable (Item 81) at J3 on Paddle Preamp Board (Item 83) by pulling out cable.
3. Remove Memory Card Board (Item 26).
4. Remove Card Cage Pre-Assembly (Item 48).
5. Remove 12-Lead Paddle Barrier (Item 106)
6. Disconnect Paddle Pickup Cable (Item 97) at J2 on Paddle Preamp Board by pulling connector out.
7. Disconnect ECG Input Connection from the 12-Lead Paddle Preamp Board at J4 and J5 by pulling on the connectors, not the wires. If any pins become bent, straighten them.
8. Slide 12-Lead Paddle Preamp Board (Item 83) up and out of the unit.

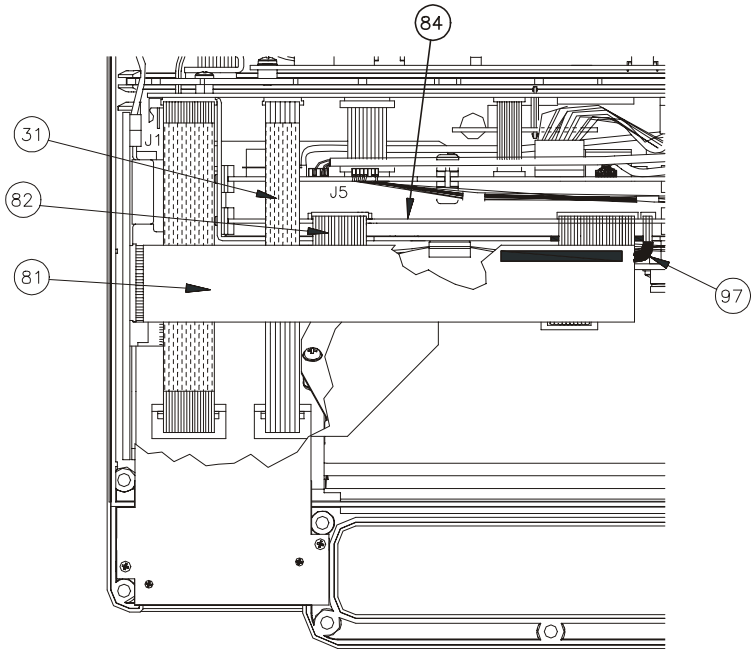
REPLACE

1. Slide 12-Lead Paddle Preamp Board (Item 83) into the unit along the two rails.
2. Connect ECG input connection to 12-Lead Paddle Preamp Board (Item 83) at J4 and J5 by pushing connector onto the metal pins. Lip on female connectors should go under

holder on male connector.

3. Connect Paddle Pickup Cable (Item 97) at J2 by pushing connector onto the metal pins.
4. Replace 12-Lead Paddle Barrier (Item 106). Replace two tapes as shown in detail 2, sheet 4.
5. Replace Card Cage Pre-Assembly (Item 48).
6. Replace Memory Card Board (Item 26).
7. Connect 12-Lead Preamp-Protection Cable (Item 81) at J3 by pushing cable into connector; the insulated side of the cable should face out of the unit.
8. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
9. Replace Bottom Enclosure (Item 21).

Item 84 – 12-Lead Preamp Board



WARNING: DO NOT touch preamp board with fingers or tools because of contamination and ESD.

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect 12-Lead Preamp-protection Cable (Item 81) at J2 by pulling on cable.
3. Disconnect 12-Lead Motherboard Cable (Item 82) at J5 by pulling on cable.
4. Disconnect Paddle Pickup Cable at Pickup Preamp at J1 by carefully pulling out connector.
5. Disconnect front panel cable (Item 31) from Motherboard (Item 46) at J108.
6. Lift 12-Lead Preamp Board (Item 84) out of Card Cage Pre-Assembly.

NOTE: Hold Card Cage down when pulling preamp board out of card cage.

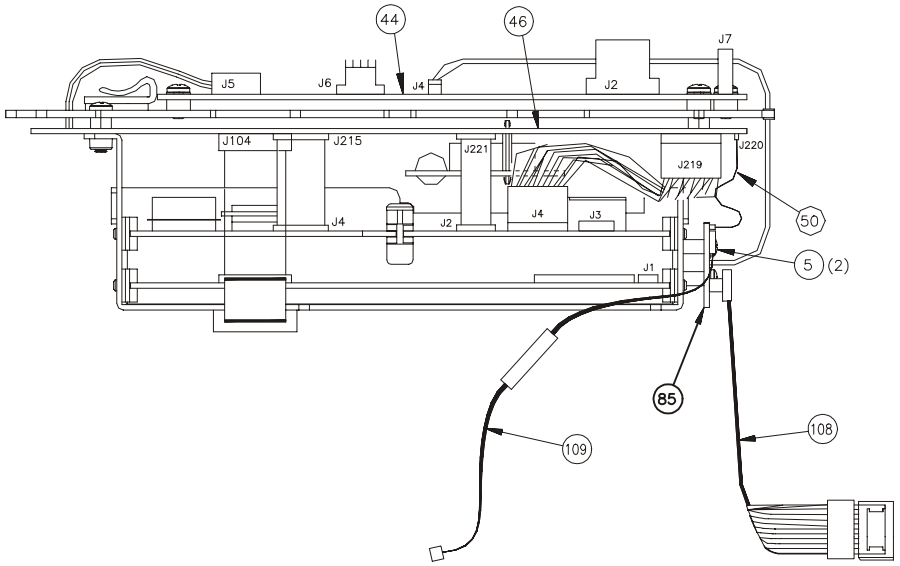
REPLACE

1. Carefully slide 12-Lead Preamp Board (Item 84) into Card Cage Pre-Assembly along two rails making sure that J5 and

J2 face up and towards the Motherboard (Item 46). Push in until movement stops and 12-Lead Preamp Board (Item 84) is flush with the Card Cage Pre-Assembly.

2. Connect paddle pickup input cable at J1 by pushing cable into connector.
3. Connect front panel cable (Item 31) at Motherboard (Item 46) J108
4. Connect 12-Lead Motherboard Cable (Item 82) at J5 by pushing cable into connector; the insulated side of the cable should face the 12-Lead Preamp Board (Item 84).
5. Connect 12-Lead Preamp-protection Cable (Item 81) at J2 by pushing cable into connector; the insulated side of the cable should face the 12-Lead Preamp Board (Item 84).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 85 – Color Display Adapter Board



NOTE: Item 85 may also include the Color Display Cable.

REMOVE

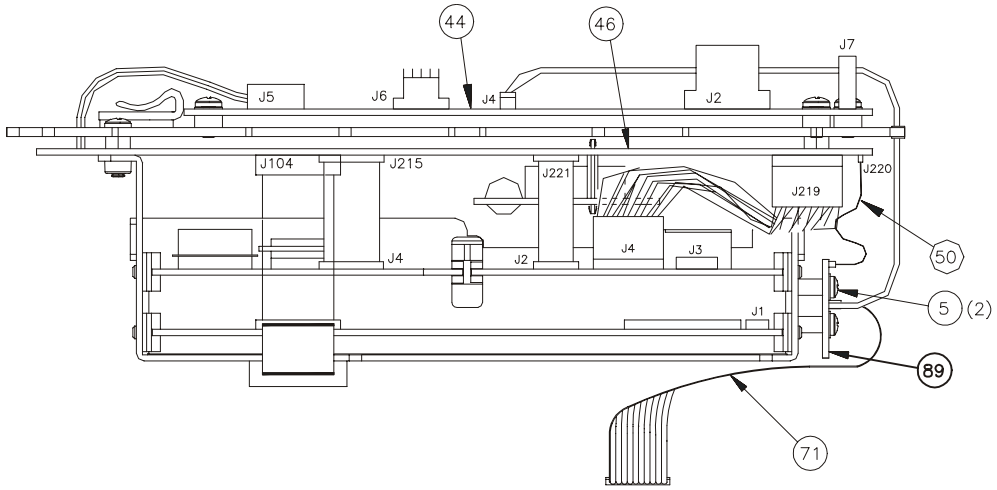
1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect Display Power Supply Cable to Power Supply Board (Item 44) at J4 by pulling on connector.
4. Disconnect Flat Panel Display Cable (Item 50) at J4 on Color Display Adapter Board (Item 85) by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
5. Disconnect the Color Inverter Cable (Item 109) at J2 on the Color Display Adapter Board (Item 85) by carefully pulling the connector out.
6. Remove two screws (Item 5) from Color Display Adapter Board (Item 85) with a #1 Phillips head screwdriver.
7. Lift Color Display Adapter Board (Item 85) off Card Cage Pre-Assembly (Item 48).

REPLACE

1. Position Color Display Adapter Board (Item 85) on the side of the Card Cage Pre-Assembly (Item 48) so that J1 is near Motherboard (Item 46).

2. Replace two screws (Item 5) of the Color Display Adapter Board (Item 85) using a #1 Phillips head screwdriver.
3. Connect Flat Panel Display Cable (Item 50) at J4 by lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the insulated side of the cable should face the back of the retaining clip.
4. Connect Display Power Supply Cable to Power Supply Board (Item 44) at J4 by pushing on connector. Lip on female connector should go under holder on male connector.
5. Replace Card Cage Pre-Assembly (Item 48).
6. Connect the Color Inverter Cable (Item 109) at J2 on the Color Display Adapter Board (Item 85) by pushing the connector in, ensuring that the visible metal terminals face up.
7. Check that cables are seated correctly in connectors and are clear of the sides of the unit.
8. Replace Bottom Enclosure (Item 21).

Item 89 – EL Display Adapter Board



REMOVE

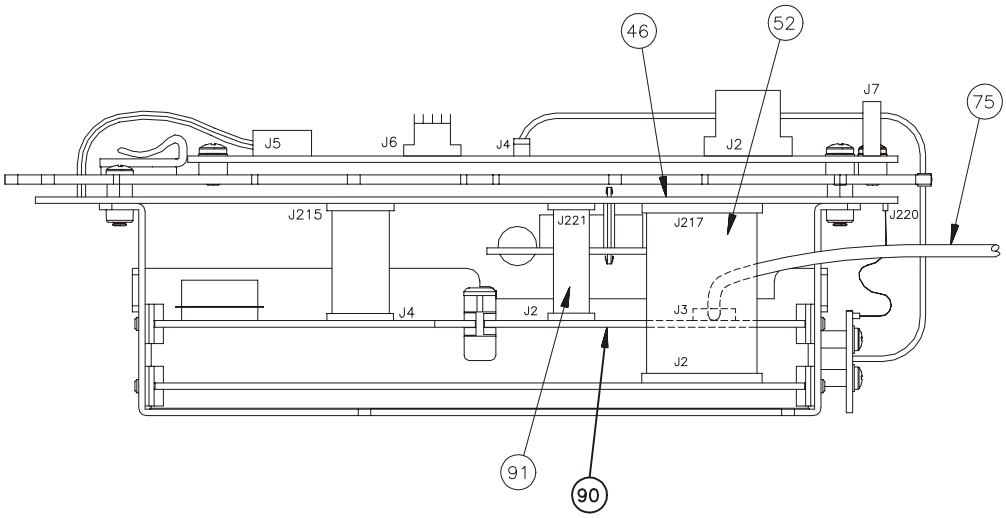
1. Remove Bottom Enclosure (Item 21).
2. Remove Card Cage Pre-Assembly (Item 48).
3. Disconnect Display Power Supply Cable from Power Supply Board (Item 44) at J4 by pulling on connector.
4. Disconnect Flat Panel Display Cable (Item 50) at J1 on EL Display Adapter Board (Item 89) by lifting retaining clip with fingernails or small instrument and carefully pulling out cable.
5. Disconnect EL Display Cable (Item 71) at J2 on EL Display Adapter Board (Item 39) by pulling up on the connector.
6. Remove two screws (Item 5) from EL Display Adapter Board (Item 89) with a #1 Phillips head screwdriver.
7. Lift EL Display Adapter Board (Item 89) off Card Cage Pre-Assembly (Item 48).

REPLACE

1. Position EL Display Adapter Board (Item 89) on the side of the Card Cage Pre-Assembly (Item 48) so that J1 is near Motherboard (Item 46).
2. Replace two screws (Item 5) of the EL Display Adapter Board (Item 89) using a #1 Phillips head screwdriver.
3. Connect EL Display Cable (Item 71) at J2 on EL Display Adapter Board (Item 39).

4. Connect Flat Panel Display Cable (Item 50) at J1 by lifting retaining clip with fingernails or small instrument, placing cable into connector, checking that cable is seated straight, and pushing down on retaining clip; the insulated side of the cable should face the back of the retaining clip.
5. Connect Display Power Supply Cable to Power Supply Board (Item 44) at J4 by pushing on connector. Lip on female connector should go under holder on male connector.
6. Replace Card Cage Pre-Assembly (Item 48).
7. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
8. Replace Bottom Enclosure (Item 21).

Item 90 – Oximeter Board, without CO_2



REMOVE

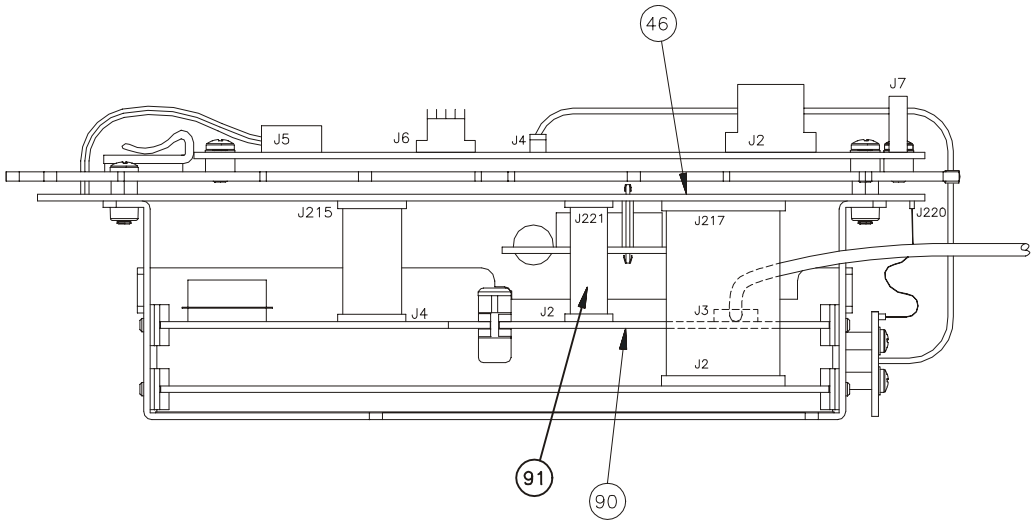
1. Remove Bottom Enclosure (Item 21).
2. Disconnect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pulling on cable.
3. Disconnect the Main Oximeter Cable (Item 91) at J2 by lifting up on the retaining clip with fingernail or a small instrument.
4. Disconnect Temperature Assembly Cable (Item 75) from the Oximeter Board at J3 by pulling on connector.
5. Push the silver knob on the card guide with finger or a small instrument so that the Oximeter Board (Item 90) will slide freely in the card guide.
6. Remove the Oximeter Board (Item 90) by sliding it out of the card guide in the Card Cage Pre-Assembly (Item 48).

REPLACE

1. Replace Oximeter Board (Item 90) by sliding the board into the card guide of the Card Cage Pre-Assembly (Item 48) with connectors J2 and J3 facing up and towards the Motherboard (Item 46).
2. Return the locking mechanism to the locked position by pushing the plastic side in with a finger or small instrument such that the mechanism clicks into place and the silver knob protrudes.

3. Connect Temperature Assembly Cable (Item 75) at J3 on Motherboard (Item 46) by pushing connector onto the metal pins.
4. Connect the Main Oximeter Cable (Item 91) at J2 by lifting retaining clip, placing cable into connector, pressing the retaining clip to the cable and then down. The insulated side of the cable should face the back of the retaining clip.
5. Connect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pushing cable into connector; the insulated side of the cable should face the Motherboard (Item 46).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 91 – Main Oximeter Cable



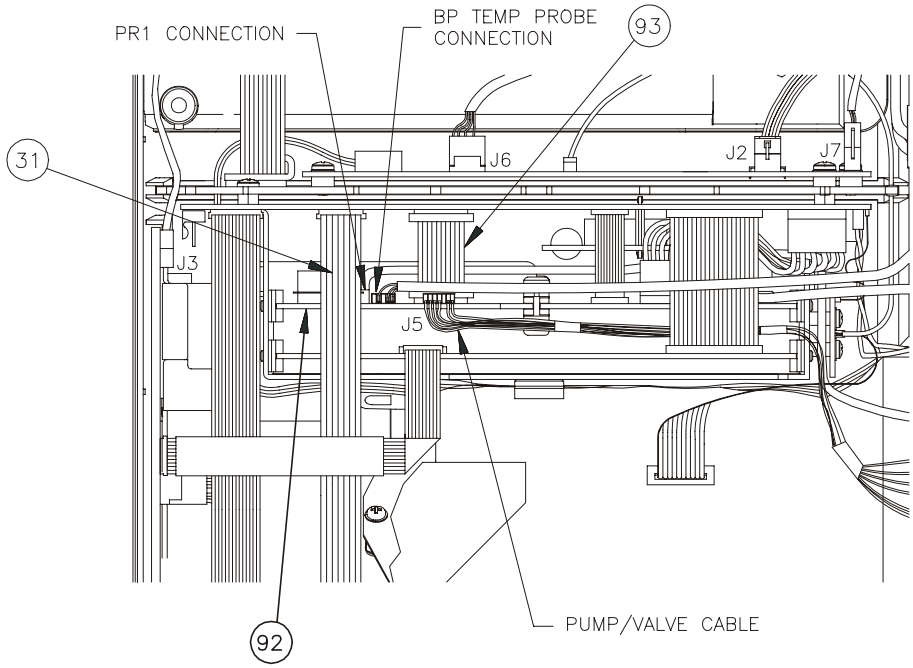
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect the Main Oximeter Cable (Item 91) at J221 on Motherboard (Item 46) by lifting up on the retaining clip with fingernail or a small instrument and pulling out cable.
3. Disconnect Main Oximeter Cable (Item 91) at J2 on Oximeter Board (Item 90 or 103) by lifting up on the retaining clip with fingernail or a small instrument and pulling out cable.

REPLACE

1. Connect Main Oximeter Cable (Item 91) at J221 on Motherboard (Item 46) by lifting up on the retaining clip with fingernail or a small instrument. Place cable in connector, then push the retaining clip toward the board and then down with a brown connector, or just push down with a white connector; the insulated side of the cable should face the back of the retaining clip.
2. Connect the Main Oximeter Cable (Item 91) at J2 on Oximeter Board (Item 90 or 103) by lifting up retaining clip with fingernail or a small instrument, placing cable into connector, then pushing the retaining clip toward the board and then down; the insulated side of the cable should face the back of the retaining clip.
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 92 – Blood Pressure Board



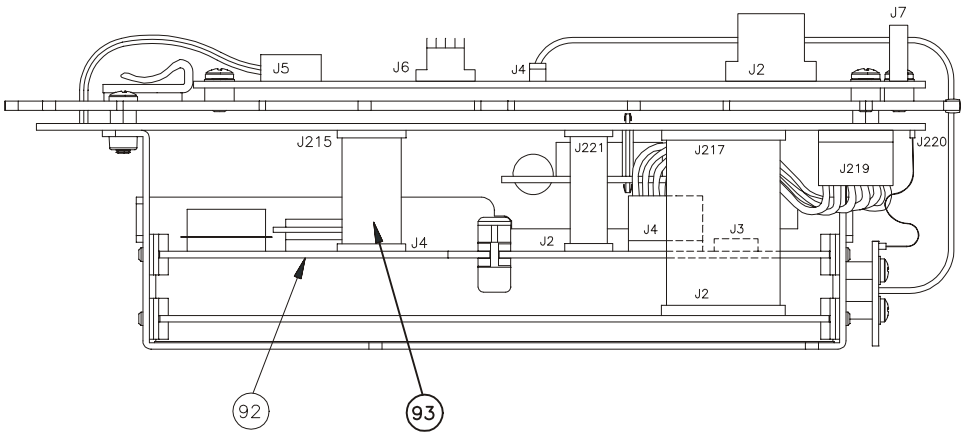
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Front Panel Cable (Item 31) from Motherboard (Item 46) at J108 by lifting up on the retaining clip with fingernail or a small instrument and pulling out cable.
3. Disconnect Blood Pressure Cable (Item 92) from J2 on Oximeter Board (Item 90) by lifting up on the retaining clip with fingernail or a small instrument and pulling out cable.
4. Disconnect Blood Pressure Main Cable (Item 93) at J4 by lifting the retaining clip with fingernail or a small instrument and carefully pulling out cable.
5. Push the silver knob on the card guide with a finger or small instrument so that the Blood Pressure Board (Item 92) will slide freely.
6. Remove Blood Pressure Board (Item 92) by sliding it out of the card guide.
7. Disconnect Hose from PR1.

REPLACE

1. Connect Hose to PR1 making sure it is securely fastened.
2. Connect the Main Oximeter Cable (Item 91) at J2 on Oximeter Board (Item 90) by lifting up retaining clip with fingernail or a small instrument, placing cable into connector, then pushing the retaining clip toward the board and then down;
3. Connect Blood Pressure Main Cable (Item 93) at J4 by lifting the retaining clip, placing cable in connector; and pushing retaining clip; the insulated side of the cable should face up.
4. Slide the rest of the board into Card Cage Pre-Assembly.
5. Return locking mechanism to the locked position by pushing the plastic side in with a finger or small instrument such that the mechanism clicks into place and the silver side in protruding.
6. Connect the Cable from the Pump/Valve Assembly (Item 69) at J5 by pushing connector onto the metal pins.
7. Connect the Temperature Probe Assembly (Item 75) to the Blood Pressure Board at J2 by pushing connector onto metal pins.
8. Connect Front Panel Cable (Item 31) to Motherboard (Item 46) at J108 by lifting up on the retaining clip with fingernail or a small instrument, placing cable into connector, checking that the cable it seated straight, and pushing down on retaining clip; the insulated side of the cable should face the back of the retaining clip.
9. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
10. Replace Bottom Enclosure (Item 21).

Item 93 – Main Blood Pressure Cable



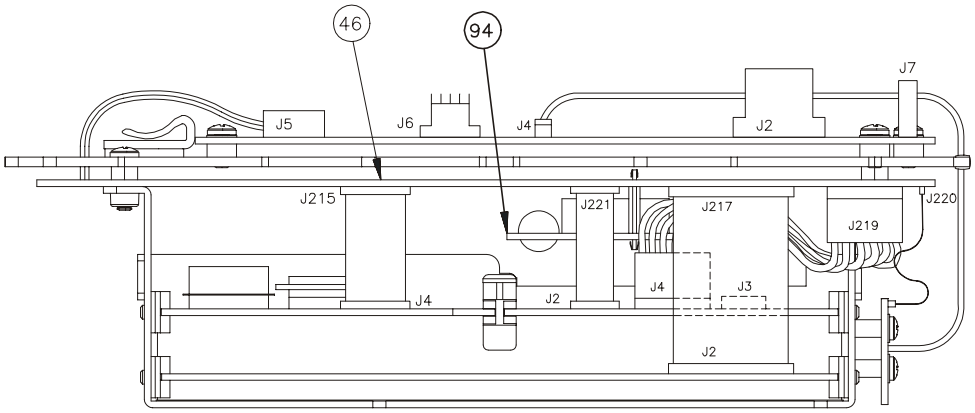
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Main Blood Pressure Cable (Item 93) at J215 on Motherboard (Item 46) by lifting the retaining clip with fingernail or a small instrument and carefully pulling out cable.
3. Disconnect Main Blood Pressure Cable (Item 93) at J4 on Blood Pressure Board (Item 92) by lifting the retaining clip with fingernail or a small instrument and carefully pulling out cable.

REPLACE

1. Connect Main Blood Pressure Cable (Item 93) at J4 on Blood Pressure Board (Item 92) by lifting retaining clip with fingernail or a small instrument, placing cable into connector, then pushing down on the retaining clip; the insulated side of the cable should face the back or the retaining clip.
2. Connect the Main Blood Pressure Cable (Item 93) at J215 on Motherboard (Item 46) by lifting up retaining clip with fingernail or a small instrument, placing cable into connector, then pushing the retaining clip down; the insulated side of the cable should face the back of the retaining clip.
3. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
4. Replace Bottom Enclosure (Item 21).

Item 94 – Speech Board



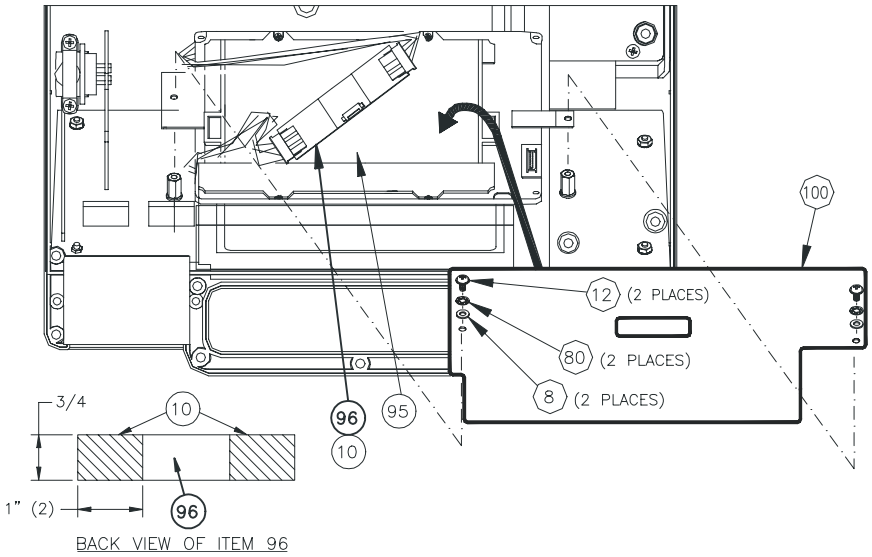
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove the Card Cage Pre-Assembly (Item 48).
3. Remove the Motherboard (Item 46).
4. Remove Speech Board (Item 94) from the Motherboard (Item 46) by carefully lifting Voice/Memo Board up, separating it from J210 and the post.

REPLACE

1. Replace Speech Board (Item 94) by securing it on J210 of the Motherboard (Item 46) and snapping on to the post.
2. Replace the Motherboard (Item 46).
3. Replace the Card Cage Pre-Assembly (Item 48).
4. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
5. Replace Bottom Enclosure (Item 21).

Item 96 – Dual Backlight Inverter



NOTE: Requires Foam Tape (Item 10) from Fastener Kit.

REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove the Color Display Shield (Item 100).
3. Disconnect Color Inverter Cable (Item 109) at CN1 on Dual Backlight Inverter (Item 96) by pulling the cable out from the connector.
4. Disconnect both Display Backlight Cables from Dual Backlight Inverter (Item 96) at CN2 and CN3 by pulling the cable out from the connector.
5. Use a flat blade to remove the double-sided foam tape (Item 10) off unit.

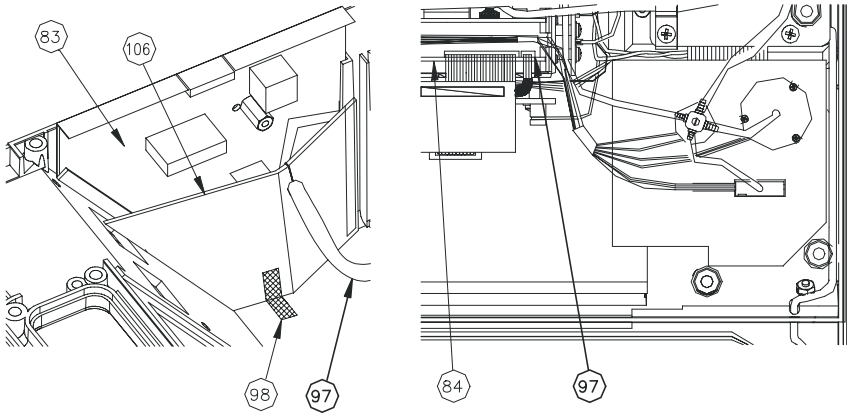
REPLACE

1. Secure Dual Backlight Inverter (Item 96) to Top Enclosure Assembly (Item 22) using the double-sided foam tape (Item 10). Use caution when pushing on tape. Do not flex board.
2. Connect both Display Backlight Cables at CN2 and CN3 by pushing on connector; arrows on male and female connectors should match up.

3. Thread Color Inverter Cable (Item 109) through hole in Shield (Item 100) and connect at CN1 on Dual Backlight Inverter (Item 96) by pushing on connector; visual metal terminals on the connector will face away from Dual Backlight Inverter (Item 96).
4. Replace the Color Display Shield (Item 100).
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

NOTE: Be careful not to flex the Dual Backlight Inverter (Item 96) when installing. Press gently on it, directly over foam tape.

Item 97 – Paddle Pickup Cable



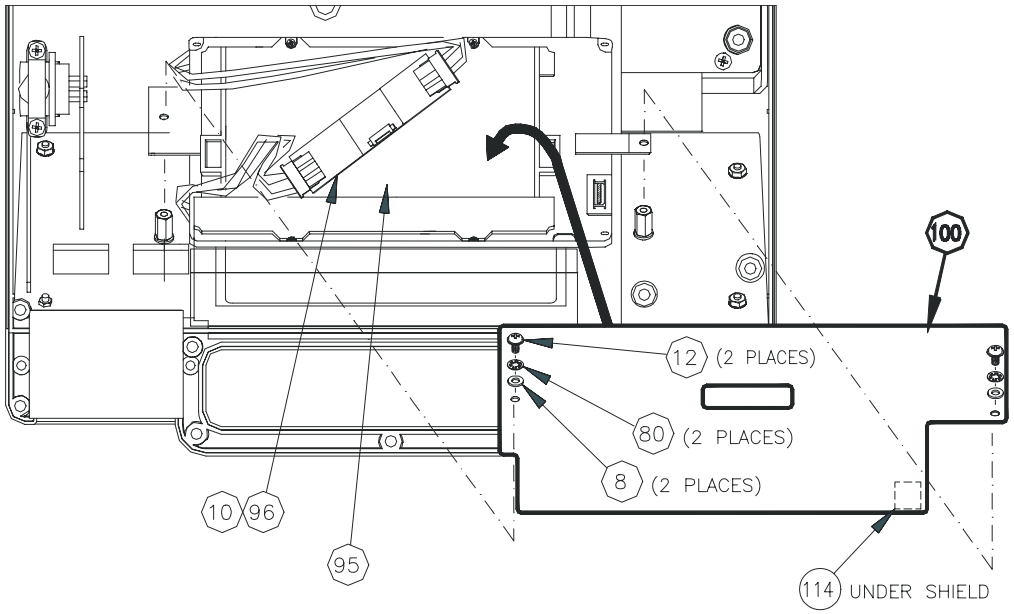
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect 12-Lead Preamp-Protection Cable (Item 81) at J3 on Paddle Preamp Board (Item 83) by pulling out cable.
3. Remove Memory Card Board (Item 26).
4. Remove Card Cage Pre-Assembly (Item 48).
5. Remove 12-Lead Paddle Barrier (Item 106)
6. Disconnect Paddle Pickup Cable (Item 97) at J2 on Paddle Preamp Board by pulling connector out.

REPLACE

1. Connect Paddle Pickup Cable (Item 97) at J2 by pushing connector onto the metal pins.
2. Replace 12-Lead Paddle Barrier (Item 106). Use double stick tape MRL #800397.
3. Replace Card Cage Pre-Assembly (Item 48).
4. Replace Memory Card Board (Item 26).
5. Connect 12-Lead Preamp-Protection Cable (Item 81) at J3 by pushing cable into connector; the insulated side of the cable should face out of the unit.
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 100 – Color Display Shield and EL Display Shield



REMOVE

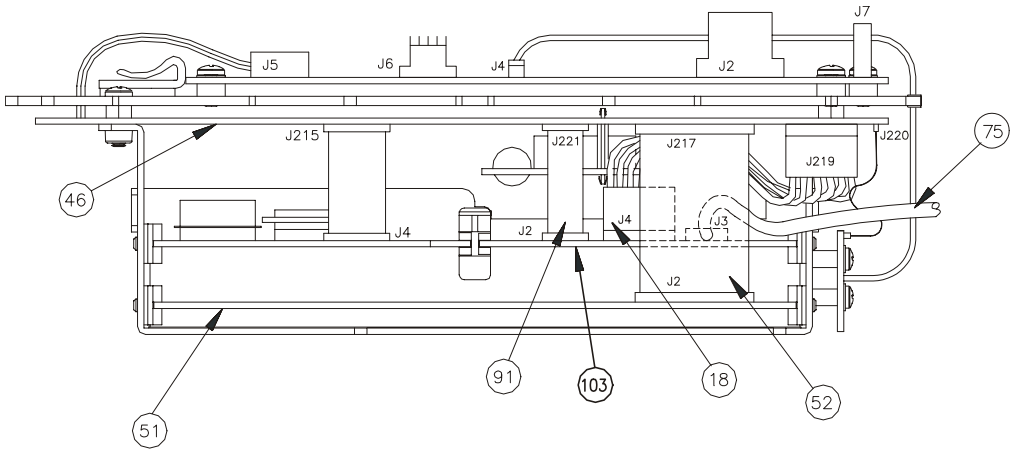
1. Remove Bottom Enclosure (Item 21).
2. Remove the Card Cage Pre-Assembly (Item 48).
3. Remove Blood Pressure Pump/Valve Assembly and the Foam Block (Items 68 and 69).
4. Disconnect the Color Inverter Cable (Item 109) from CN1.
5. Remove Memory Card Board (Item 26).
6. Remove ferrite and double-sided tape (Item 10) from the Shield.
7. Remove screws on either side of the Color Display Shield (Item 100).
8. Lift Color Display Shield away from unit.

REPLACE

1. Thread the Backlight Inverter Cable (Item 109) through Shield. Place Color Display Shield back into unit, with the cut out corner by the color display connector. Adhere shield to display with one inch of double-sided tape (Item 10).
2. Replace screws.

3. Replace Card Cage Assembly (Item 48).
4. Replace Memory Card Board (Item 26).
5. Tuck ferrite from Item 108 under the display shield and secure with double-sided tape (Item 10).
6. Replace Blood Pressure Pump/Valve Assembly and Foam Block (Items 68 and 69).
7. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
8. Replace Bottom Enclosure (Item 21).

Item 103 – Oximeter Board, with CO_2



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pulling on the cable.
3. Disconnect the Main Oximeter Cable (Item 91) at J2 by lifting up on the retaining clip with fingernail or small instrument.
4. Disconnect Temperature Assembly Cable (Item 75) from the Oximeter Board at J3 by pulling on connector.
5. Disconnect CO_2 Cable (Item 18) at J4 by pulling on connector.
6. Push the silver knob on the center card guide with a finger or a small instrument so that the Oximeter Board (Item 103) will slide freely in the card guides.
7. Remove the Oximeter Board (Item 103) by sliding it out of the card guides in the Card Cage Pre-Assembly (Item 48).

REPLACE

1. Replace Oximeter Board (Item 103) by sliding it into card guides in the Card Cage Pre-Assembly (Item 48) with connectors J2 and J3, up and facing Motherboard (Item 46).
2. Return the locking mechanism to the locked position by pushing the plastic side in with a finger or small instrument so the silver knob protrudes.

3 Connect CO_2 Cable (Item 18) to Oximeter Board (Item 103) at J4 by pushing connector onto the metal pins.

4. Connect Temperature Assembly Cable (Item 75) at J3 on Motherboard (Item 46) by pushing connector onto metal pins.

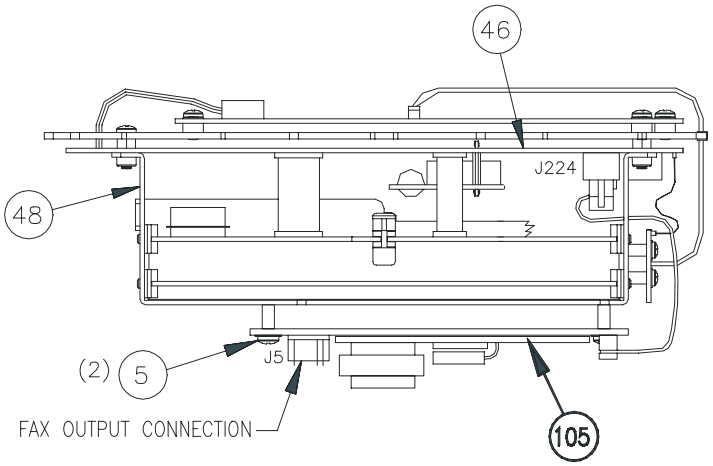
5. Connect the Main Oximeter Cable (Item 91) at J2 by lifting retaining clip, placing cable in the connector, and pressing clip in. The insulated side of the cable should face the back of retaining clip.

6. Connect the Preamp Motherboard Cable (Item 52) at J217 on the Motherboard (Item 46) by pushing cable into connector. The insulated side of the cable should face the Motherboard (Item 46).

7. Check that all cables are fully seated in connectors and are clear of the sides of the unit.

8. Replace Bottom Enclosure (Item 21).

Item 105 – Modem Board



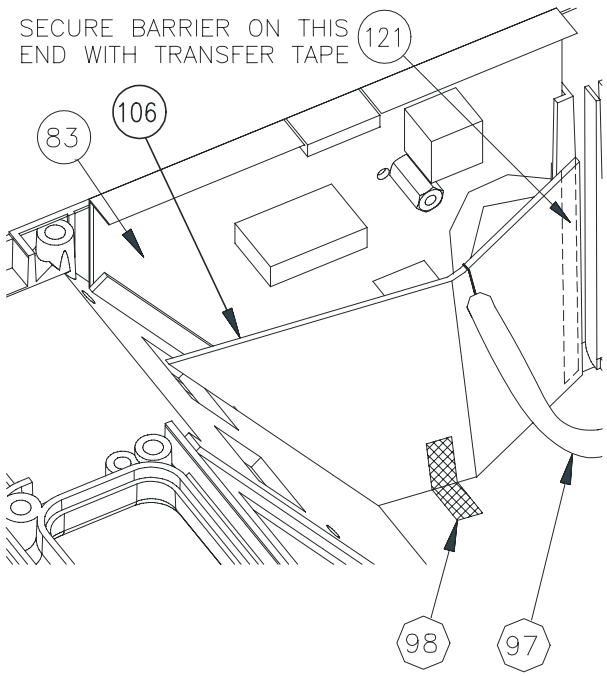
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Disconnect Fax Output at J5 by lifting up on connector.
3. Remove the Card Cage Pre-Assembly (Item 48) from unit.
4. Disconnect Modem Cable (Item 109) from J224 on Motherboard (Item 46).
5. Remove screws (Item 5).
6. Remove Modem Board (Item 105) from Card Cage Pre-Assembly (Item 48).

REPLACE

1. Replace Modem Board (Item 105) from Card Cage Pre-Assembly (Item 48), lining up holes, attach using screws (Item 5).
2. Connect Modem Cable to J224 on Motherboard (Item 46), making sure to match notches.
3. Replace Card Cage Assembly (Item 48).
4. Connect Fax Output Cable at J5 by pushing connector into the metal pins.
5. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
6. Replace Bottom Enclosure (Item 21).

Item 106 – 12-Lead Paddle Barrier



NOTE: Requires Conductive Tape (Item 98) and Transfer Tape (Item 121) from Fastener Kit (Item 16).

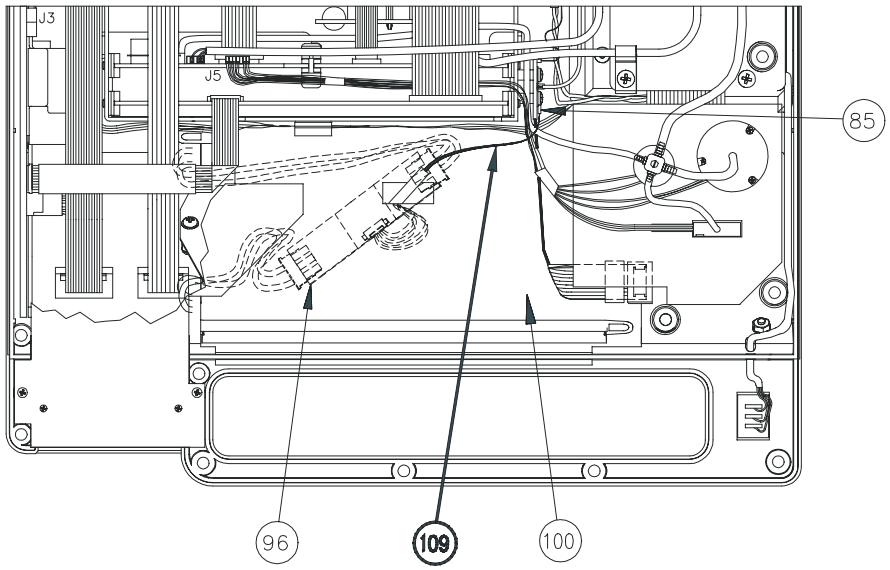
REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Memory Card Board (Item 26).
3. Remove the Card Cage Pre-Assembly (Item 48) from unit.
4. Carefully remove Paddle Pickup Cable (Item 97) from slit in Barrier (Item 106)
5. Remove conductive tape (Item 98) from the Top Enclosure (Item 22).
6. Remove Transfer Tape (Item 121) from Barrier (Item 106) and Top Enclosure (Item 22).
7. Remove Barrier (Item 106).

REPLACE

1. Secure Barrier (Item 106) to Top Enclosure (Item 22) with Adhesive Transfer Tape (Item 121) along one whole edge.
2. Attach Conductive Tape (Item 98) to Barrier and Top Enclosure.
3. Replace Paddle Input Cable from slit in Barrier (Item 106).
4. Replace Card Cage Assembly (Item 48).
5. Replace Memory Card Board (Item 26).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

Item 109 – Color Inverter Cable



REMOVE

1. Remove Bottom Enclosure (Item 21).
2. Remove Blood Pressure Pump/Valve Assembly and Foam Block (Items 69 & 68).
3. Remove the Color Display Shield (Item 100).
4. Disconnect Color Inverter Cable (Item 109) at J2 on Color Display Adapter Board (Item 85) by pulling on the cable by the connector.
5. Disconnect Color Inverter Cable (Item 109) at CN1 on Dual Backlight Inverter (Item 96) by pulling on the cable by the connector and threading cable out of hole in Color Display Shield (Item 100).

REPLACE

1. Thread cable through hole in Color Display Shield (Item 100).
2. Connect Color Inverter Cable (Item 109) at CN1 on Dual Backlight Inverter (Item 96) by pushing on the connector; visible metal terminals on female connector should face away from the Dual Backlight Inverter (Item 96).
3. Replace the Color Display Shield (Item 100).
4. Connect Color Inverter Cable (Item 109) at J2 on Color

Display Adapter Board (Item 85) by pushing on connector; visible metal terminals on female connector should face away from the Color Display Adapter Board (Item 85).

5. Replace Blood Pressure Pump/Valve Assembly and Foam Block (Items 69 & 68).
6. Check that all cables are seated correctly in connectors and are clear of the sides of the unit.
7. Replace Bottom Enclosure (Item 21).

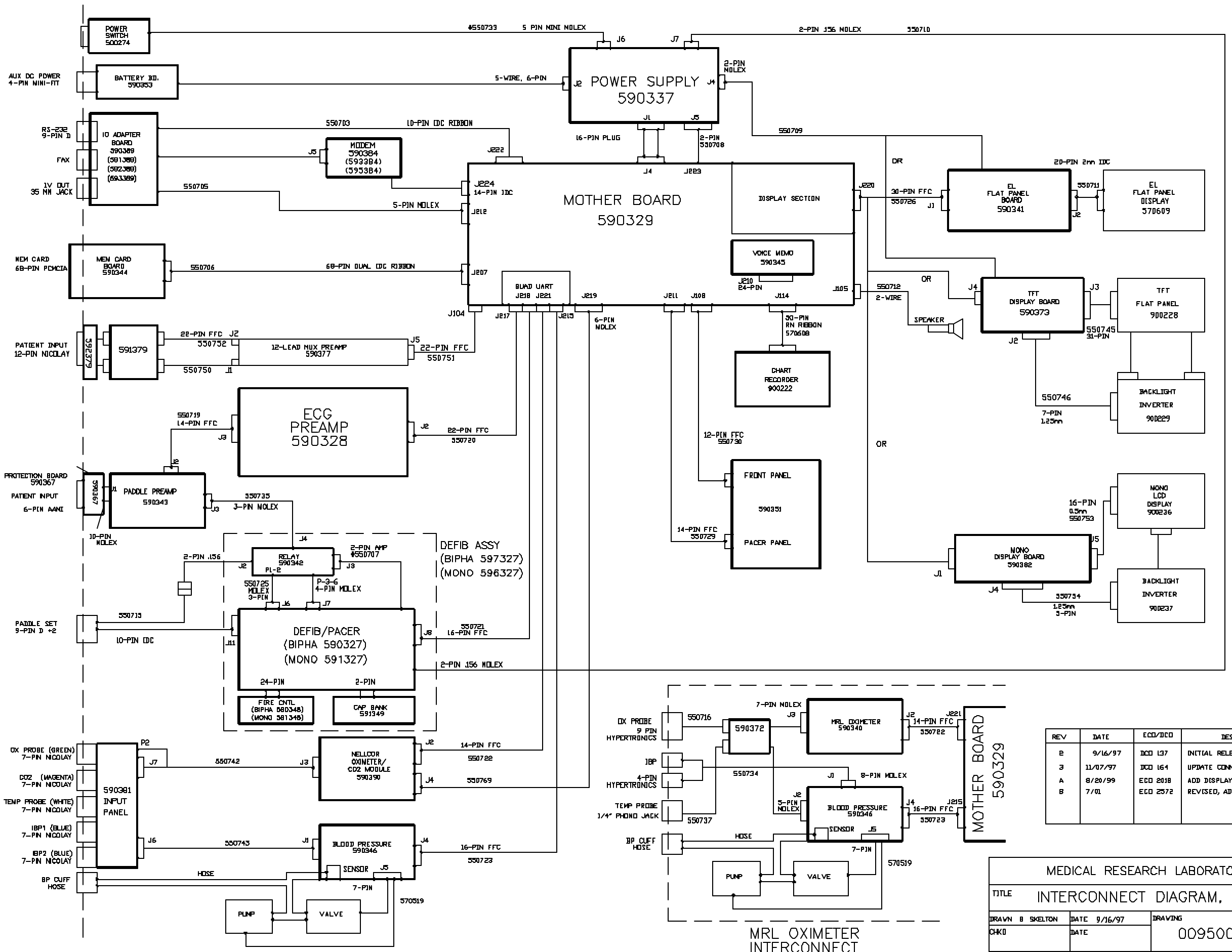
CHAPTER 9: ASSEMBLY DRAWINGS

This Chapter contains nine assembly drawings for the PIC System Service Drawings (Part Number 991012).

Chapter Overview:

- *Table of Item Numbers . . . . . Sheet 1*
- *Top Assembly . . . . . Sheet 2*
- *5-Lead Unit . . . . . Sheet 3*
- *12-Lead Unit . . . . . Sheet 4*
- *No Defib . . . . . Sheet 5*
- *MRL Oximeter Option and Power Wiring. . . . . Sheet 6*
- *MRL LITE . . . . . Sheet 7*
- *EL, Color TFT, and Mono Display Options . . . . . Sheet 8*
- *Card Cage Assembly . . . . . Sheet 9*

PIC INTERCONNECT DIAGRAM



REV	DATE	ECO/DCO	DESC.
E	9/16/97	DCO 137	INITIAL RELEASE
J	11/07/97	DCO 164	UPDATE CONNECTOR NUMBERS
A	8/20/99	ECO 2018	ADD DISPLAY OPTIONS/12LD
B	7/01	ECO 2572	REVISED, ADD BIPHA DEFIB

MEDICAL RESEARCH LABORATORIES

TITLE: INTERCONNECT DIAGRAM, PIC

DRAWN B SKELTON	DATE 9/16/97	DRAWING 009500	REVISION B
CHK'D	DATE		

FILE F:\DRAWINGS\ACAD\0\0009500.DWG

ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #1856 RELEASE	IG	11/98
B	ECO #2018 ADD DISPLAY OPTIONS	GS	05/99
C	ECO #2169 ADD MONO DISP. & BATTERY	MH	11/4/99
D	ECO #2572	KDM	1/01

ITEM	MRL PART#	DESCRIPTION	QTY.
126	800104	SHRINK TUBE 3/8" CLEAR	3 in
125	800105	SHRINK TUBE 1/2", CLEAR	5-5/8 in
124	PT. OF ITEM 21	PIC IO AD BD (1V, RS232)	1 *
123	800386	SUPER GLUE TUBE	.001
122	PT OF ITEM 21	PIC IO AD BD 1V,FAX,RS232	1 *
121	PT. OF ITEM 16	TAPE ADHESIVE TRANSFER	3 in
120	800302	TAPE ELEC.1 SCOTCH #56	4 75 in
119	150299	HEYCO PLUG #2491	1 *
118	PT. OF ITEM 65	LABEL, SERIAL NO PIC	1
117	15D130	'O' RING #012 BUNA 70	1 *
116	790055	FERRITE, FEC, 0.610"	1 *
115	62050D	BOARD, SPACER, PIC BP/OX	1 *
114	PT. OF ITEM 16	DBL COATED FOAM TAPE .062	1.5 in
113	PT. OF ITEM 22	BLOCK PIC M-CARD PLUG	1
112	15D605	PCB, GUIDE, TENSION RACK	1
111	15D607	PCB, GUIDE, DBL CHANNEL	1
110	560540	PIC PAD CONNECTOR	1 *
109	550746	COLOR INVERTER CABLE	1 *
108	550745	COLOR DISPLAY CABLE	1 *
107	600435	BARRIER, MEMORY CARD	1 *
106	620431	BARRIER, 12-LEAD PADDLE	1 *
105	SEE CHAP 10	FAX/MODEM BOARD	1 *
104	PT OF ITEM 21	PIC IO ADAPTER BD (1V)	1 *
103	590390	CO2/OX ISOLATION BOARD	1 *
102	150358	CAP, PLASTIC 1/8ID, RED	1
101	PT. OF ITEM 21	PIC IO AD BD (1V, FAX)	1 *
100	PT. OF ITEM 22	SHIELD, PIC DISPLAY, FLAT	1 *
99	620463	BARRIER, NELLCOR OX	1 *
98	PT. OF ITEM 16	TAPE,COND FABRIC 1/2"WIDE	1.5 in
97	550750	CABLE, PIC, PADDLE PICKUP	1
96	900229	INVERTER DUAL BACKLIGHT	1 *
95	PT. OF ITEM 22	DISPLAY TFT640X480 6.4"	1 *
94	590345	PCB ASSY SPEECH	1 *
93	550723	CABLE PIC BP-MAIN	1 *
92	590346	PCB ASSY BLOOD PRESSURE	1 *
91	550722	CABLE PIC OX-MAIN	1 *
90	590340	BOARD ASSY OXIMETER	1 *
89	590341	EL DISPLAY ADAPTER BOARD	1 *
88	592379	12-LEAD PROT. BOARD	1 *
87	550743	CABLE CONN BD BP	1
86	620438	LOCKING WASHER, BP CONN.	1 *
85	590373	COLOR DISPLAY ADAPTER BOARD	1 *
84	590377	12-LEAD PREAMP BOARD	1 *
83	591379	12-LEAD PADDLE-PREAMP BD	1 *
82	550751	12-LEAD MOTHERBOARD CABLE	1 *
81	550752	12-LEAD PREAMP-PROTEC CBL	1 *

ITEM	MRL PART#	DESCRIPTION	QTY.
80	PT. OF ITEM 16	WASHER #4 INTL TOOTH ZINC	2 *
79	PT. OF ITEM 22	ASSY PIC EL DISPLAY	1 *
78	PT. OF ITEM 65	LABEL, FRONT PANEL	1
77	550742	CABLE CONN BD OX	1
76	PT. OF ITEM 22	BLOCK/CONN MTG 12 LEAD	1
75	590372	BOARD ASSY/PIC TEMP	1 *
74	800123	TUBE 1/8" ID 1/4" OD VIN	13 in
73	151239	COUPLING, BP AIR	1 *
72	PT. OF ITEM 65	LABEL, 12-LEAD INPUT	1
71	550711	CABLE PIC EL DISPLAY	1 *
70	PT. OF ITEM 65	LABEL BP HOSE	1 *
69	570519	BP PUMP/VALVE ASSEMBLY	1 *
68	620424	FOAM BLK / BP MOUNTING	1 *
67	PT. OF ITEM 65	LABEL ABBR INSTR.	1
66	PT. OF ITEM 22	CABLE ASSY PIC PADDLES	1
65	SEE CHAP 10	LABEL KIT	1
64	PT. OF ITEM 65	LABEL, SERIAL NUMBER	1
63	PT. OF ITEM 65	LABEL, CAL LOG	1
62	PT. OF ITEM 65	LABEL, CHART PAPER	1
61	PT. OF ITEM 65	LABEL CHART RECORDER	1
60	150137	O RING 20mm x 1mm CS	1 *
59	PT. OF ITEM 65	LABEL PATIENT INPUT	1 *
58	500274	POWER SWITCH	1
57	550733	CABLE PIC POWER SWITCH	1
56	900402	BATTERY, 3V-COIN CELL	1
55	550712	SPEAKER ASSEMBLY	1
54	590353	BATTERY BOARD	1
53	570608	ASSY PIC. RECORDER CABLE	1
52	550720	CABLE PIC PREAMP-M	1 *
51	590328	5-LEAD PREAMP BOARD	1 *
50	550726	CABLE PIC FLAT PANEL	1
49	590382	MONO DISPLAY ADAPTER	1 *
48	-----	ASSY / MOTHER BD CAGE	1
47	601187	CARD CAGE BRACKET	1
46	SEE CHAP 10	PCB ASSY PIC MOTHER	1 *
45	601182	PLATE CARD CAGE ASSY	1
44	590337	PCB ASSY PIC PWR SUP.	1
43	900237	INVERTER SINGLE BACKLT	1 *
42	PT. OF ITEM 22	ASSY/LCD MONO DISPLAY	1 *
41	PT. OF ITEM 22	BRACKET, PIC MONO LCD	1 *

ITEM	MRL PART#	DESCRIPTION	QTY.
40	590367	5-LD PATIENT INPUT CONN BD	1 *
39	601181	PATIENT INPUT BRACKET	1 *
38	610280	BATTERY BOARD COVER	1
37	800329	SILICON RTV	.001
36	900222	CHART RECORDER	1
35	550753	MONO LCD CABLE	1 *
34	550754	LCD INVERTER CABLE	1 *
33	550747	CABLE, PIC CAPACITOR	1 *
32	550719	CABLE PIC PREAMP-P	1 *
31	550730	CABLE PIC FRONT PANEL	1
30	550729	CABLE PIC PACER PANEL	1
29	610288	SHIELD / PIC DEFIB PREAMP	1 *
28	620417	BARRIER PIC PDL PREAMP	1 *
27	590343	5-LEAD PADDLE PREAMP BOARD	1 *
26	590344	MEMORY CARD BOARD	1
25	PT. OF ITEM 65	LABEL / POWER SWITCH	1
24	SEE CHAP 10	ASSY PIC INPUT PANEL	1 *
23	SEE CHAP 10	ASSY PIC DEFIB MODULE	1 *
22	SEE CHAP 10	ASSY TOP ENCLOSURE PIC	1 *
21	SEE CHAP 10	ASSY BOTTOM ENCLOSURE PIC	1 *
20	611282	CHART RECORDER COVER	1
19	550721	CABLE PIC DEFIB-MAIN	1
18	550769	CABLE, CO2 - MOTHER BOARD	1 *
17	971029	AC SUPPLY/PADDLE TRAY MODULE	1 *
16	002110	FASTENER KIT	1
15	550706	CABLE MEMORY CARD PP95	1
14	PT. OF ITEM 65	LABEL, PADDLE TRAY, LEDS	1
13	PT. OF ITEM 16	SCREW PPH 6-32 X 1/2	4
12	PT. OF ITEM 16	SCREW PPH .004 40 X .5"	2 *
11	PT. OF ITEM 16	SCR PFH 6-32-1/4 UND CT	1
10	PT. OF ITEM 16	TAPE, DOUBLE SIDED, 1"	3 in
9	PT. OF ITEM 16	SCREW, 6 X 3/8"L.	6
8	PT. OF ITEM 16	WASHER .312 .148 .015	3 *
7	PT. OF ITEM 16	SEAL PIC RECORDER	1
6	PT. OF ITEM 16	SCREW PPH .004 40 X .312	5
5	PT. OF ITEM 16	SCREW 4-40 X .25 PPHS	7
4	PT. OF ITEM 16	SCREW, 6-32 X 3/4" PFH	1 *
3	PT. OF ITEM 16	6-32X3/8 L SS TAMPER-RES	4
2	PT. OF ITEM 16	SCREW 6-32 X 5/16 PPH S	8
1	PT. OF ITEM 16	SCREW PPH SEAL 6-32 X 3/8	9

* ONLY INSTALLED IF CORRESPONDING OPTION IS INCLUDED

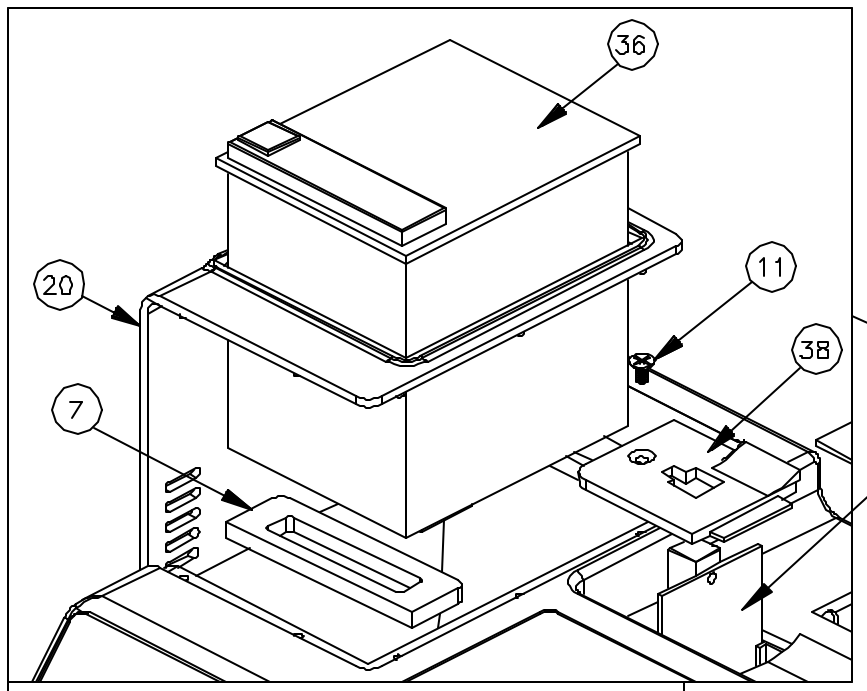
MRL medical research laboratories, inc.

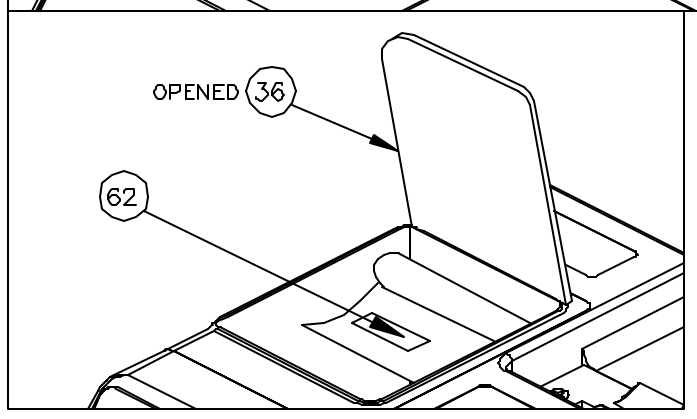
TITLE PIC SERVICE DRAWING

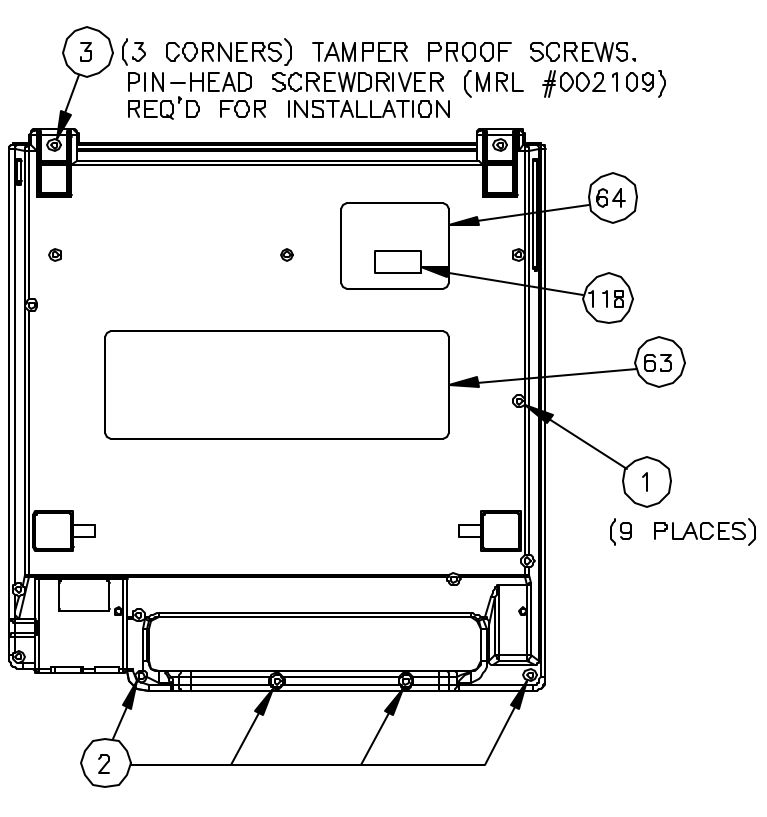
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 1 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

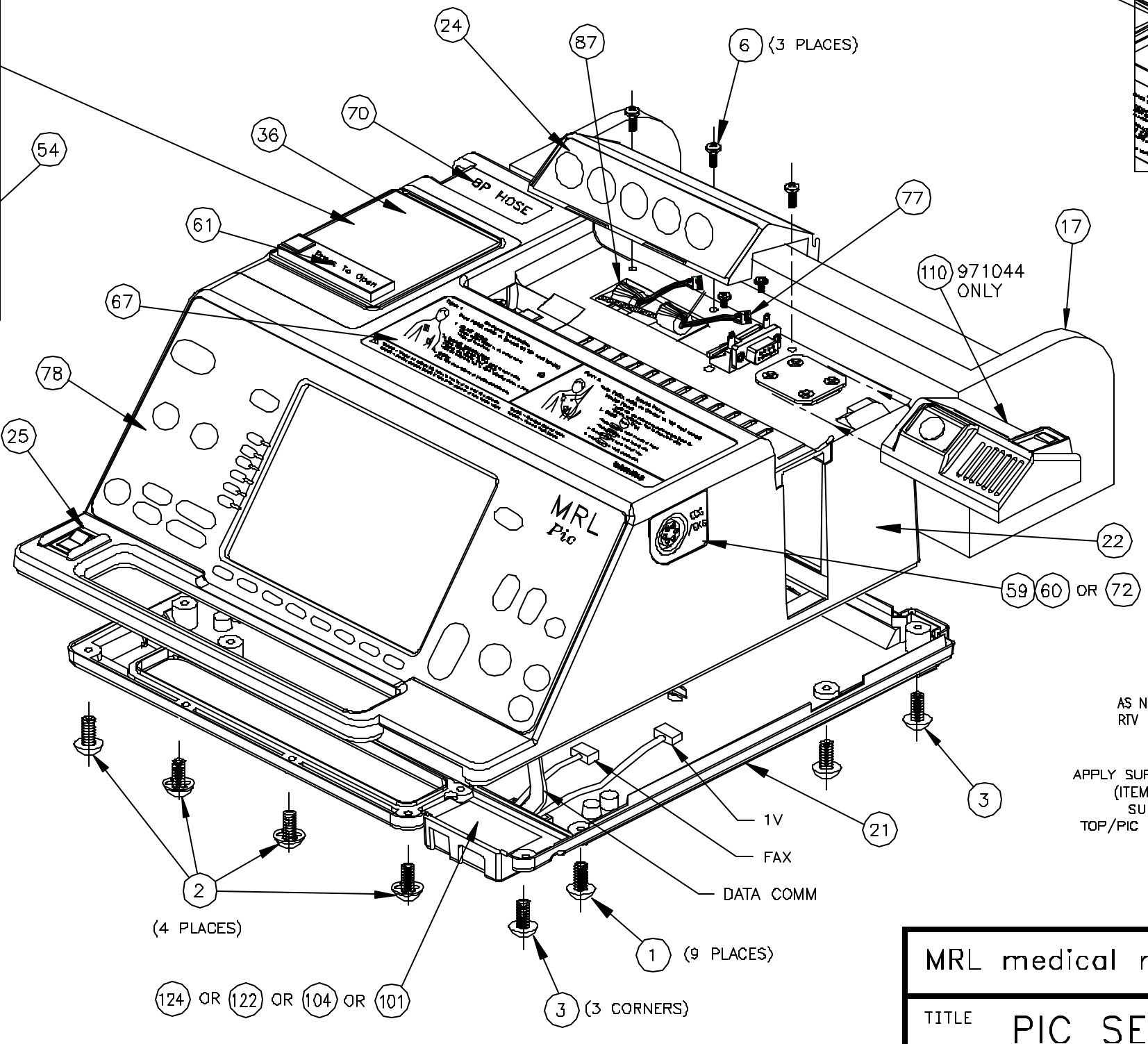
DRAWINGS INCLUDE ALL OPTIONS

DETAIL 8

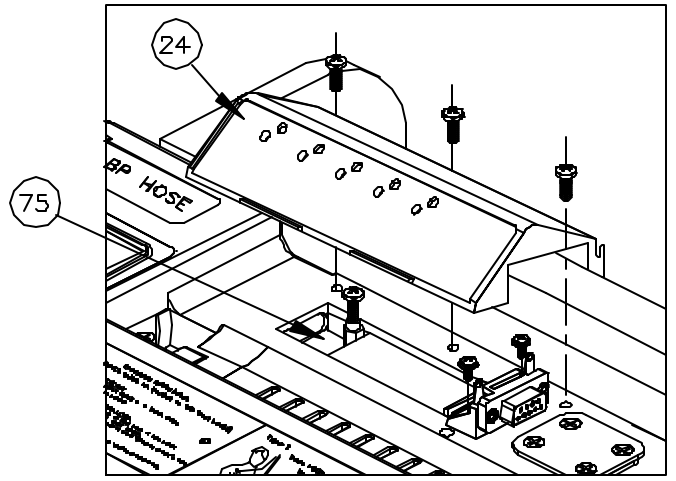








MRL OXIMETER OPTION- 971002



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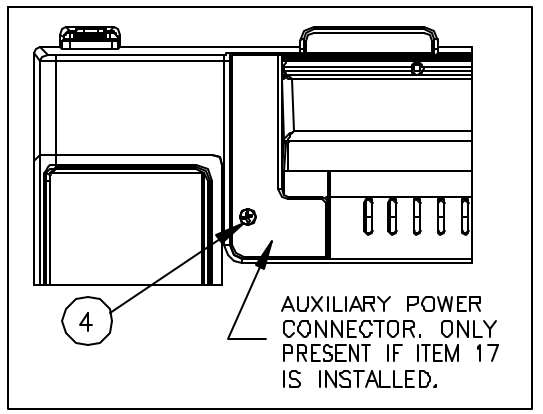
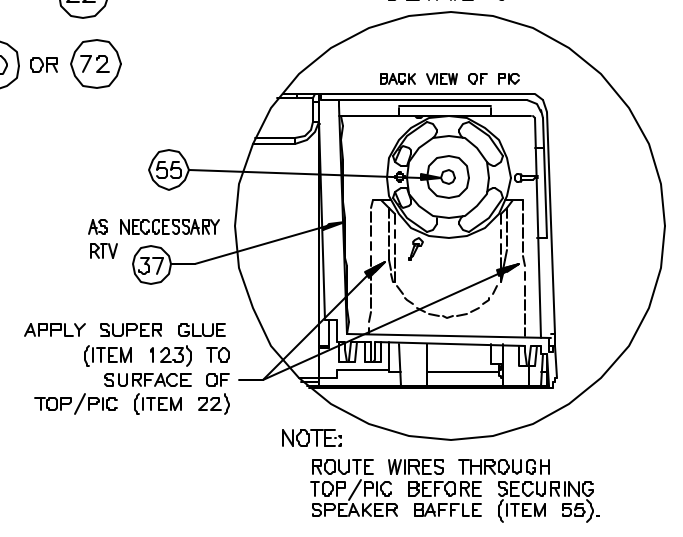


DETAIL 9



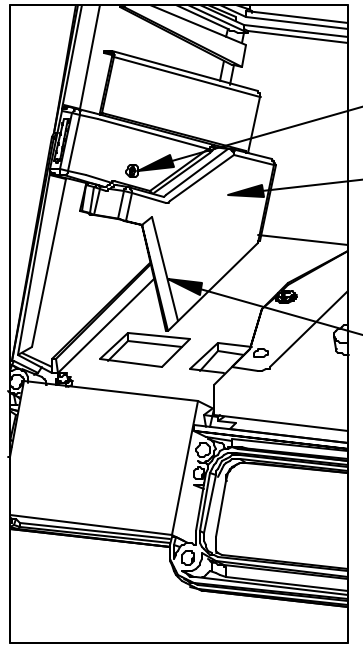
NOTE:
ROUTE WIRES THROUGH
TOP/PIC BEFORE SECURING
SPEAKER BAFFLE (ITEM 55).

MRL medical research laboratories, inc.

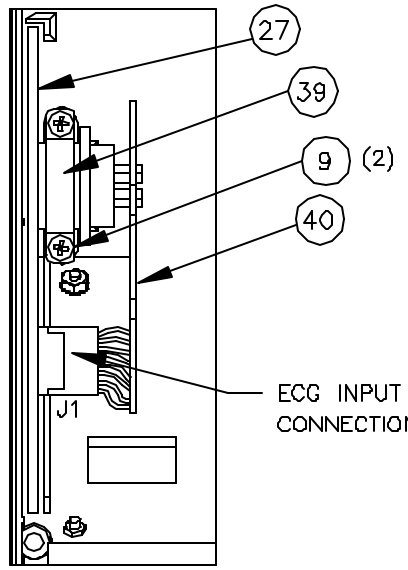
TITLE	PIC SERVICE DRAWING		
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 2 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

5 LEAD UNIT-971078, 971082

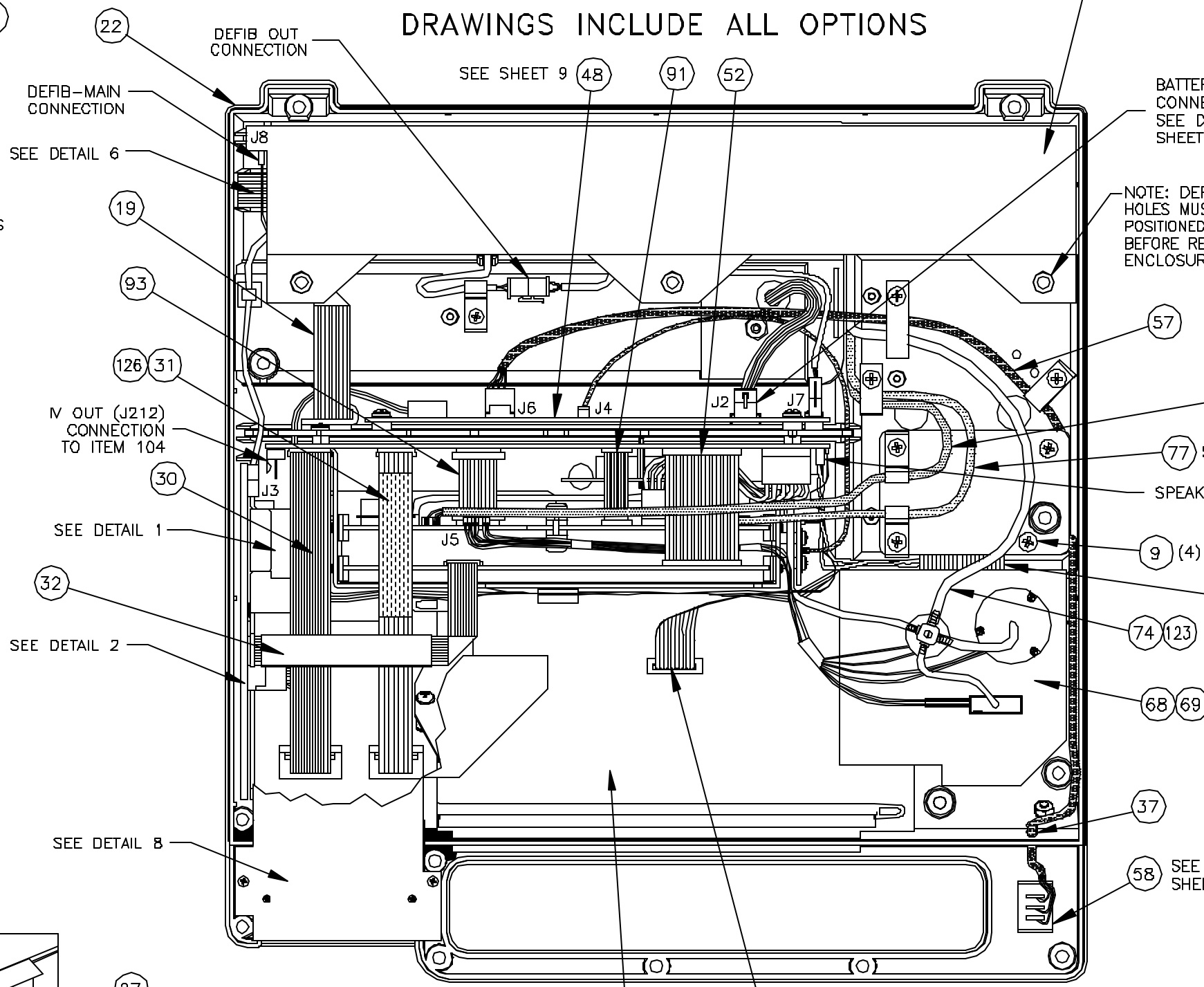
DRAWINGS INCLUDE ALL OPTIONS



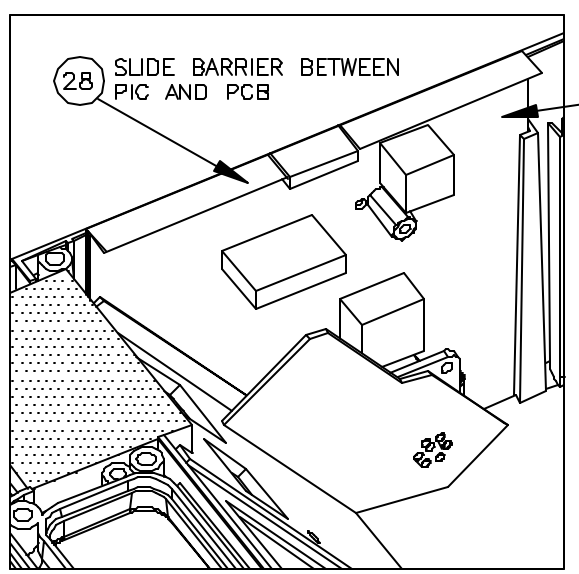
DETAIL 1



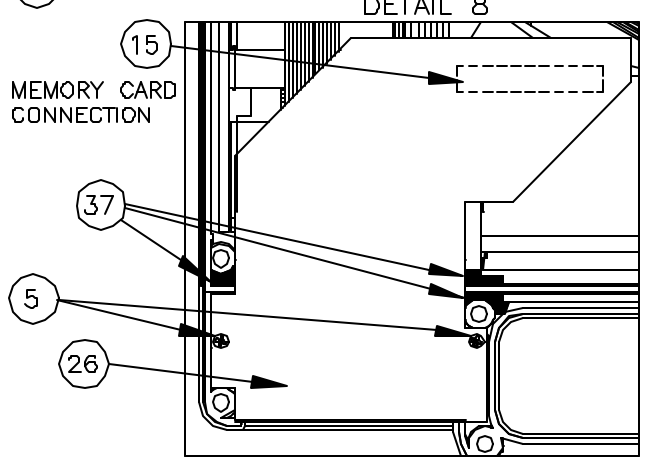
DETAIL 2
(WITHOUT SHIELD)



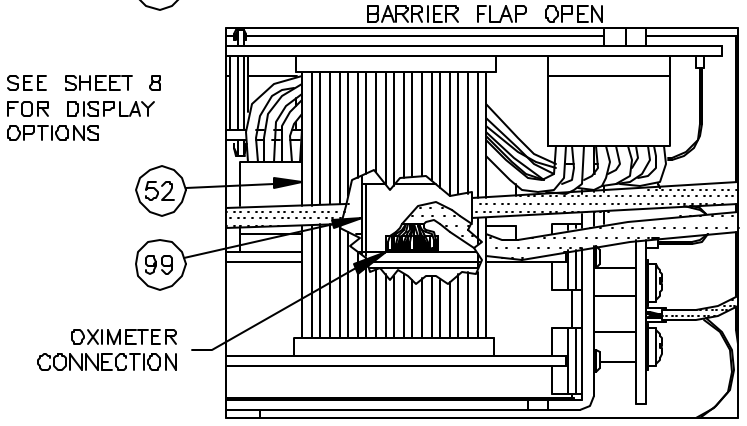
DETAIL 3



DETAIL 8



DETAIL 7
BARRIER FLAP OPEN



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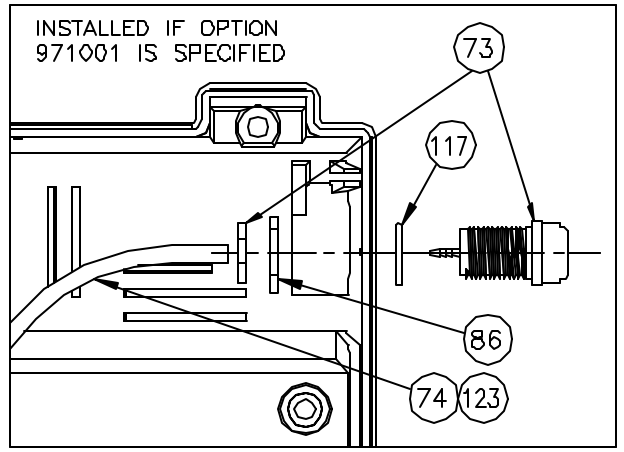

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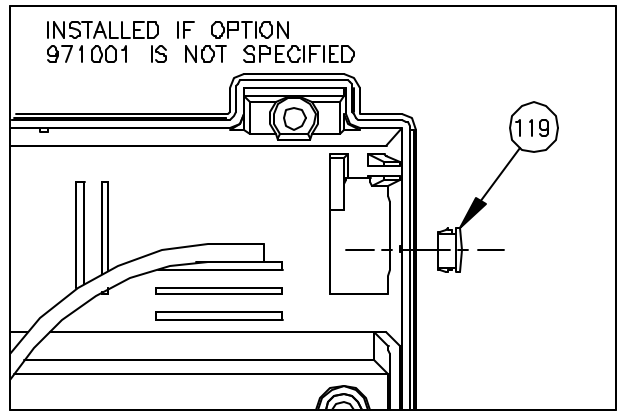
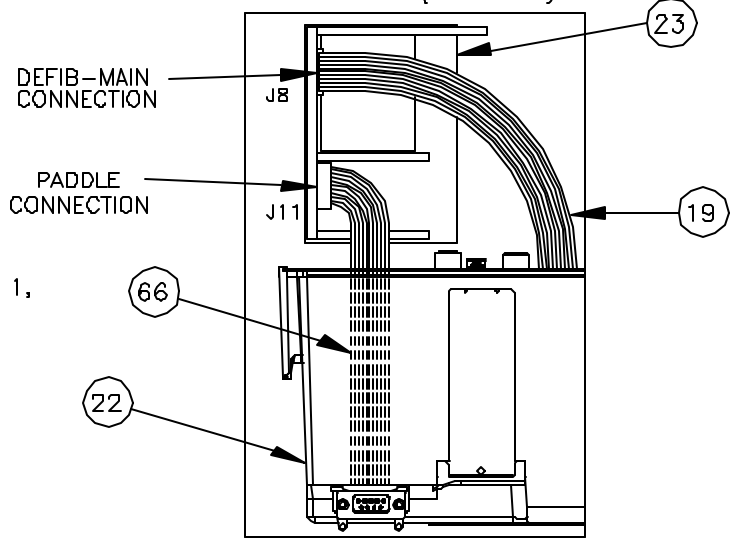


DETAIL 6
SIDE VIEW (EXPLODED)



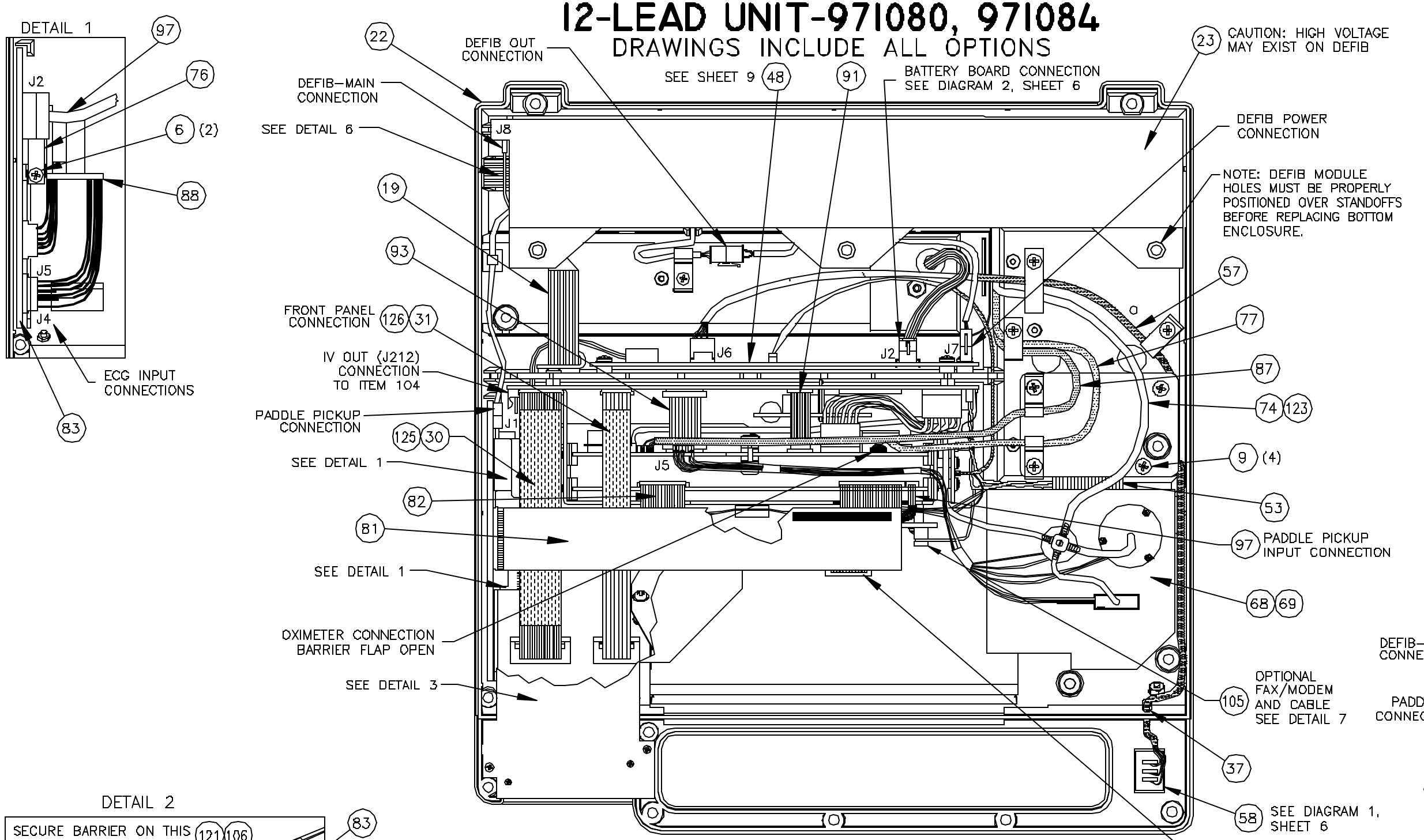
MRL medical research laboratories, inc.

TITLE: PIC SERVICE DRAWING

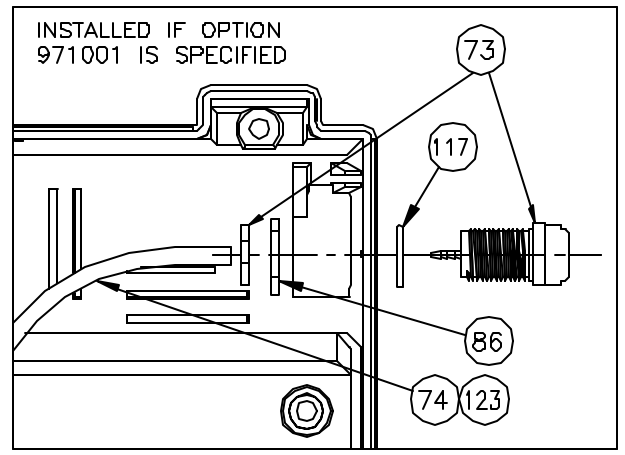
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 3 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

12-LEAD UNIT-971080, 971084

DRAWINGS INCLUDE ALL OPTIONS



DETAIL 4



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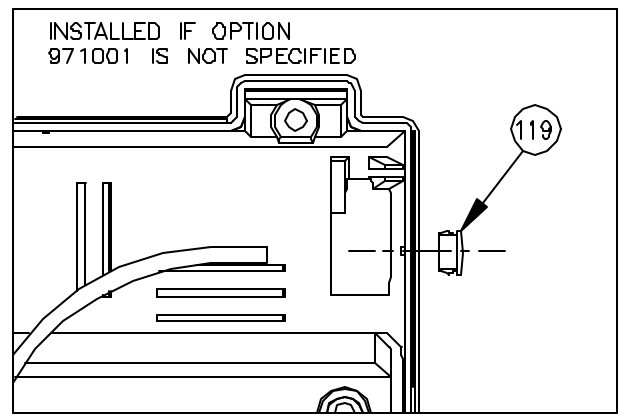
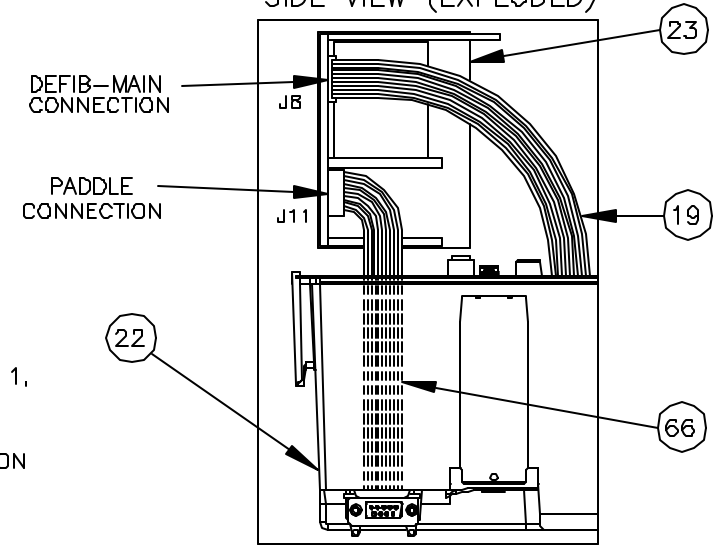
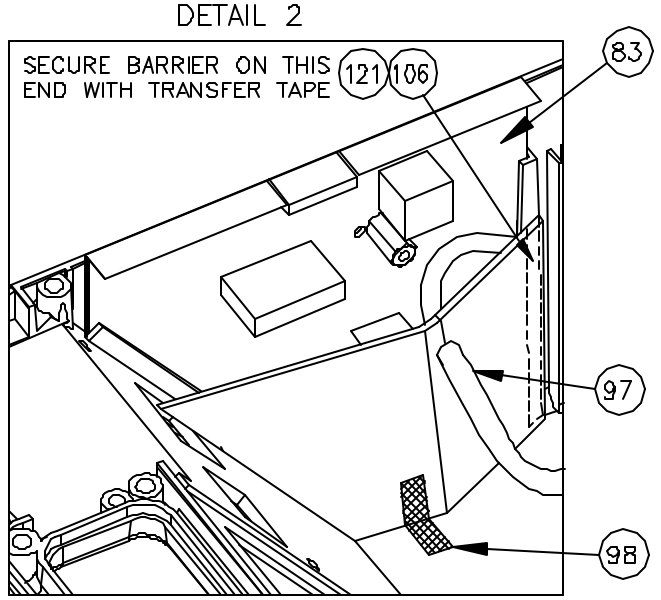


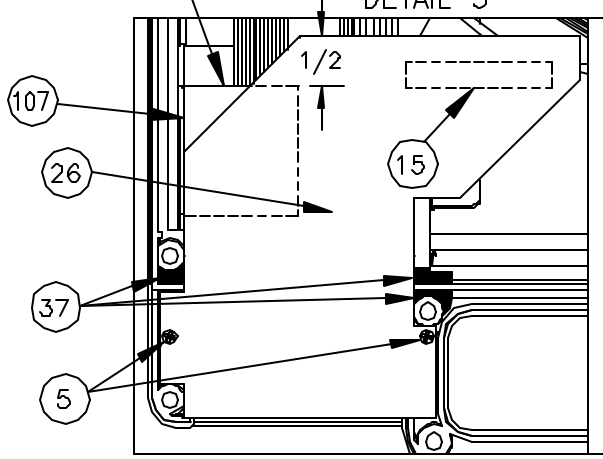
DETAIL 6
SIDE VIEW (EXPLODED)



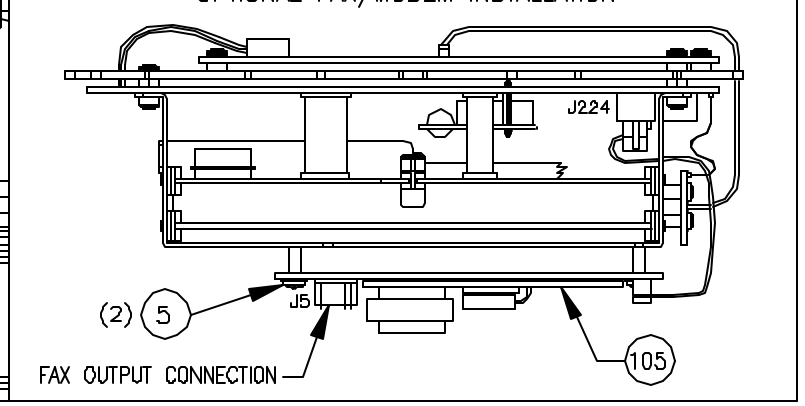
DETAIL 2



DETAIL 3



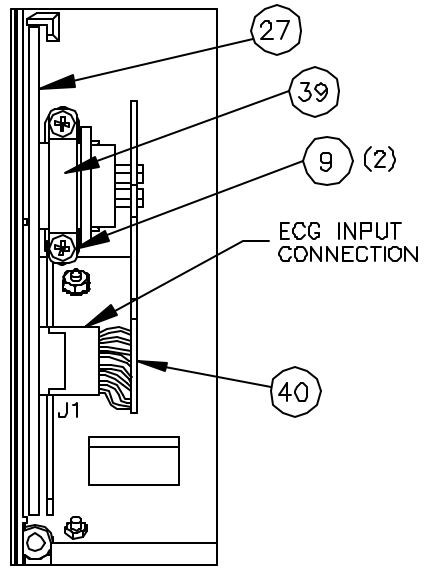
DETAIL 7
OPTIONAL FAX/MODEM INSTALLATION



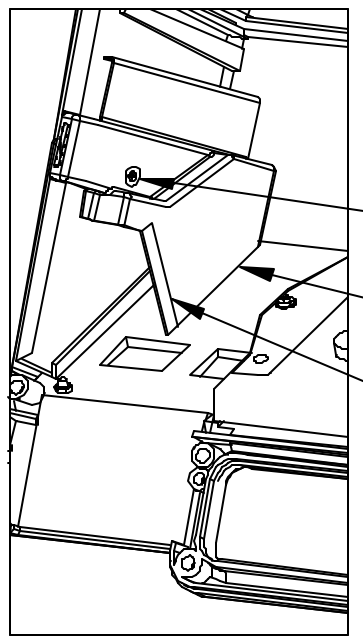
MRL medical research laboratories, inc.			
TITLE PIC SERVICE DRAWING			
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 4 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

MONITOR - NO-DEFIB - 971044

DRAWINGS INCLUDE ALL OPTIONS

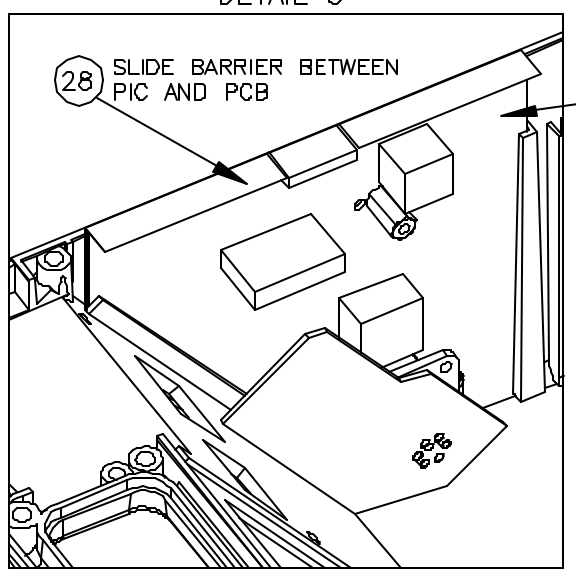


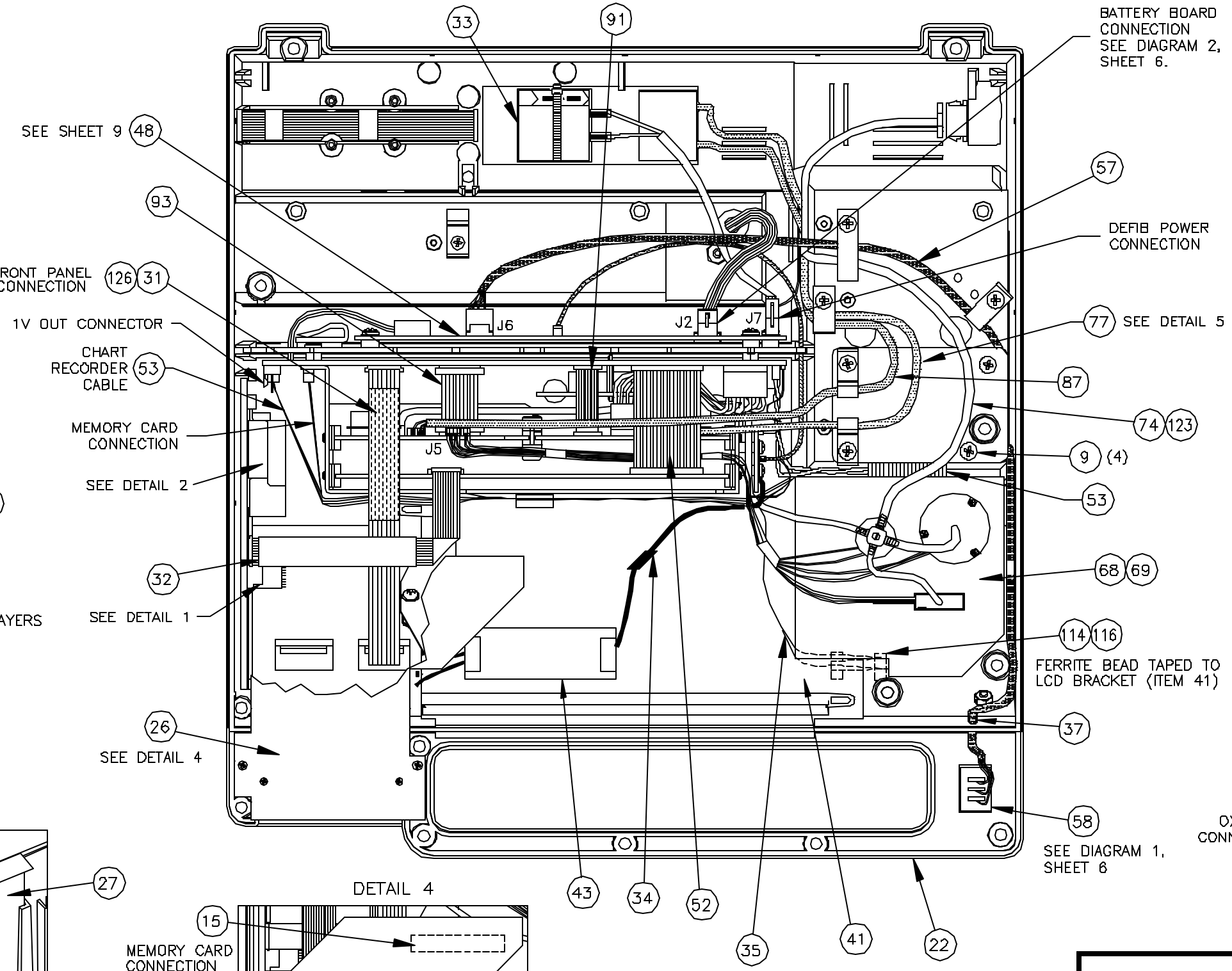
DETAIL 1
(WITHOUT SHIELD)



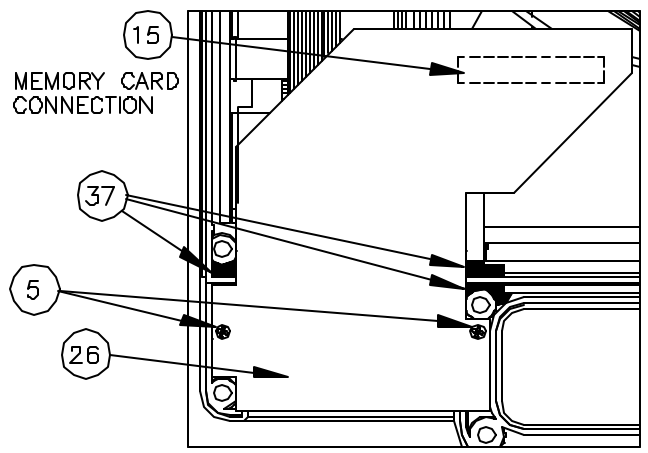
DETAIL 2

DETAIL 3

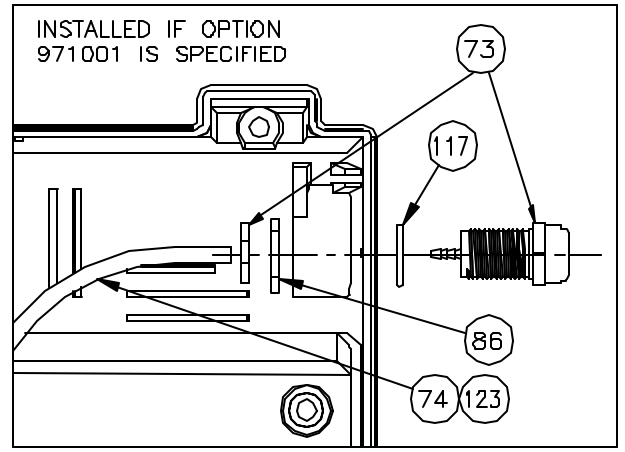




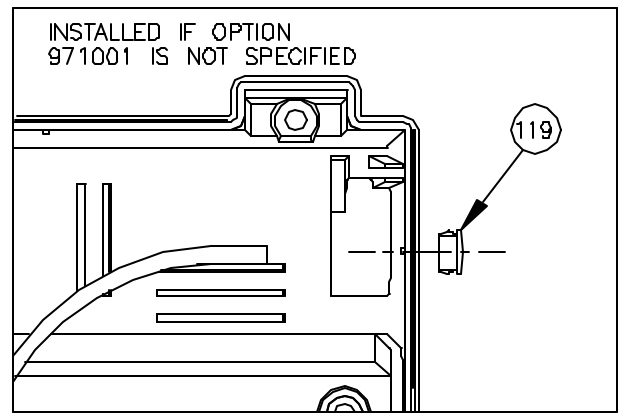
DETAIL 4



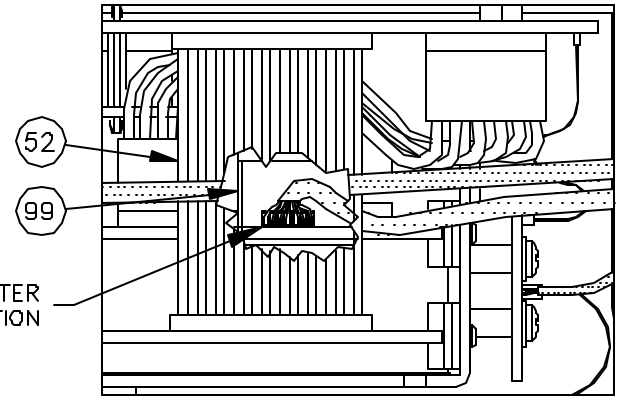
DETAIL 7



DETAIL 6



DETAIL 5
BARRIER FLAP OPEN



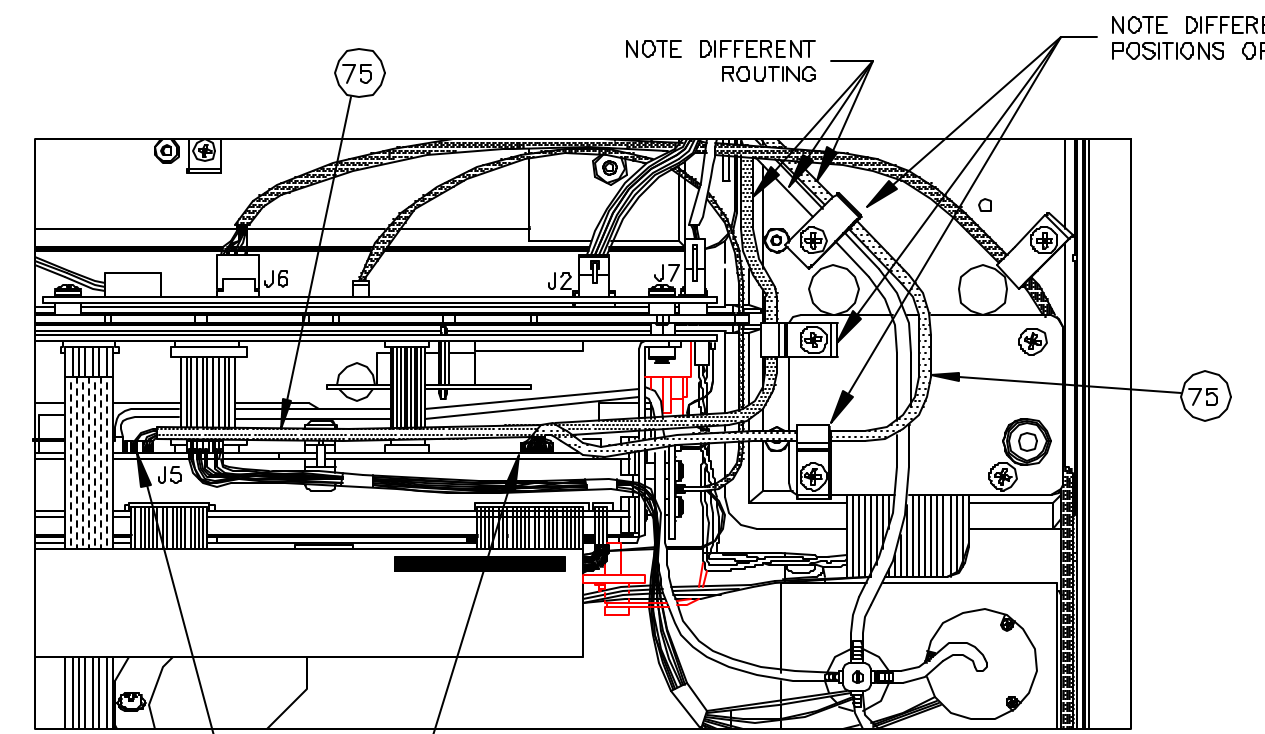
MRL medical research laboratories, inc.

TITLE: PIC SERVICE DRAWING

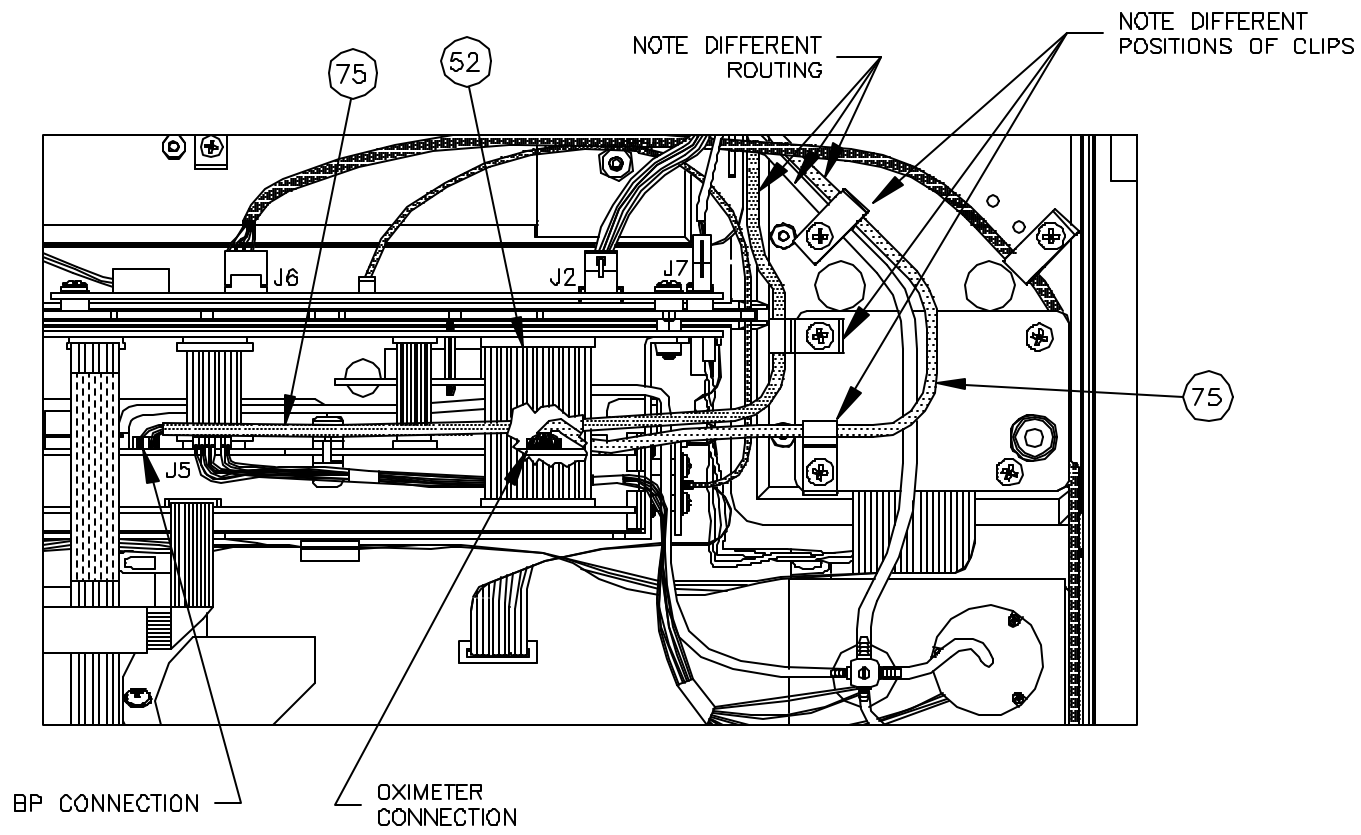
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 5 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

MRL OXIMETER OPTION - 971002

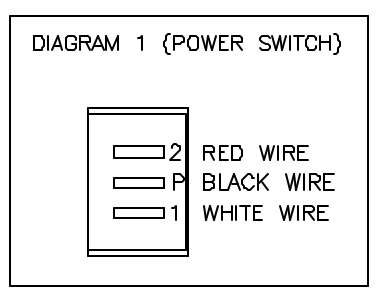
12 – LEAD

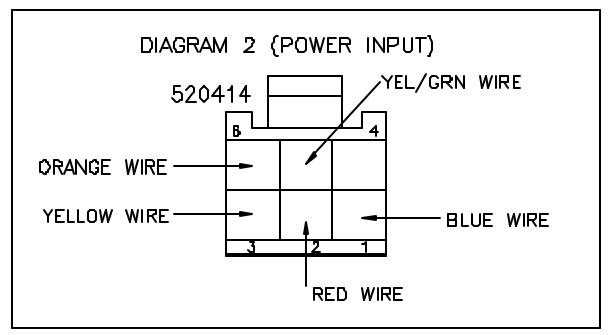


5 – LEAD



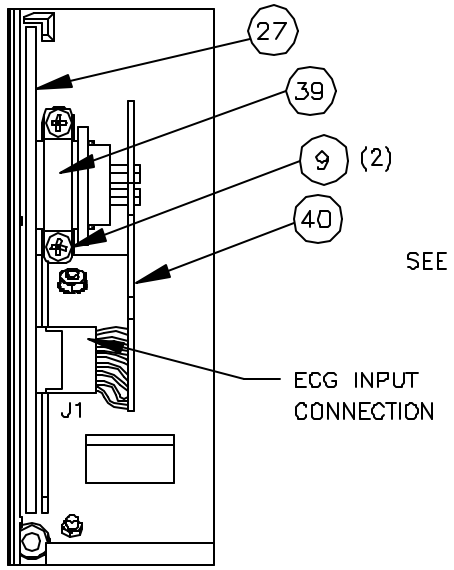
POWER WIRING DIAGRAMS





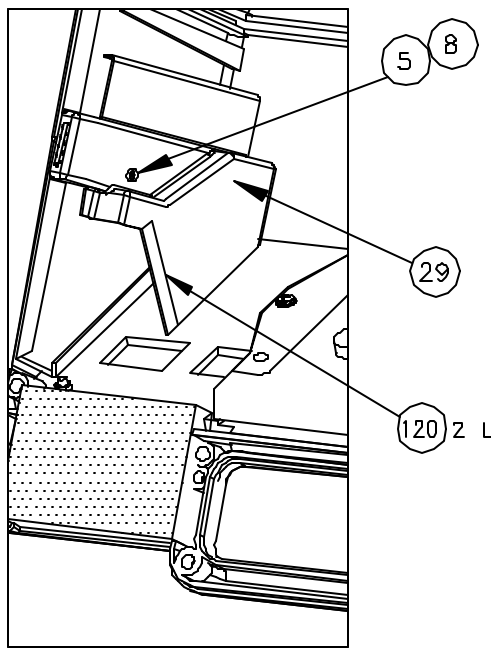
MRL medical research laboratories, inc.			
TITLE PIC SERVICE DRAWING			
DRAWN M. HOWORKO	DATE 01/00	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 6 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

MRL LITE - 971039

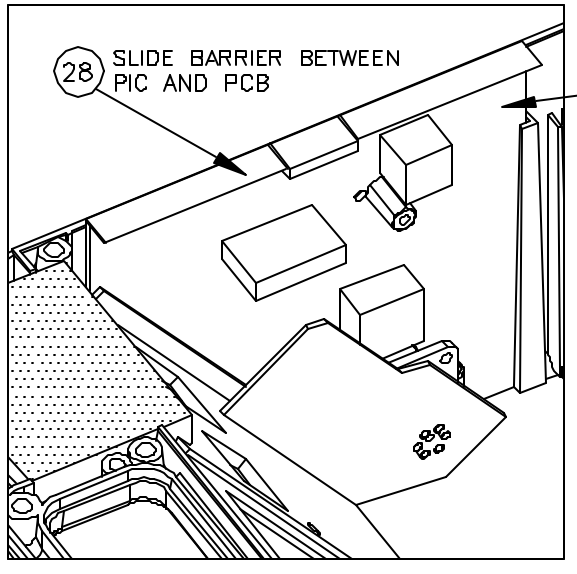


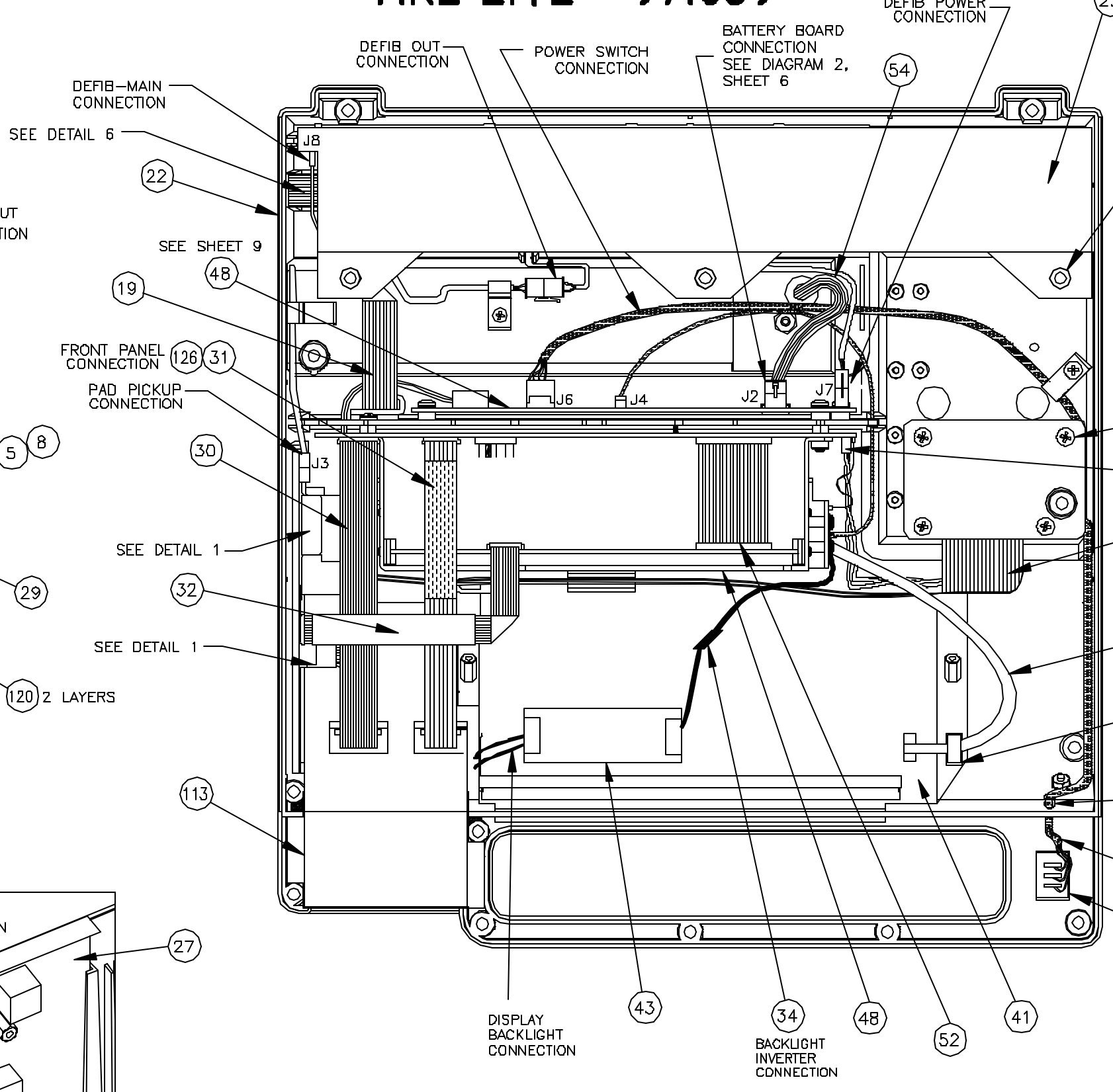
DETAIL 1
(WITHOUT SHIELD)

DETAIL 3

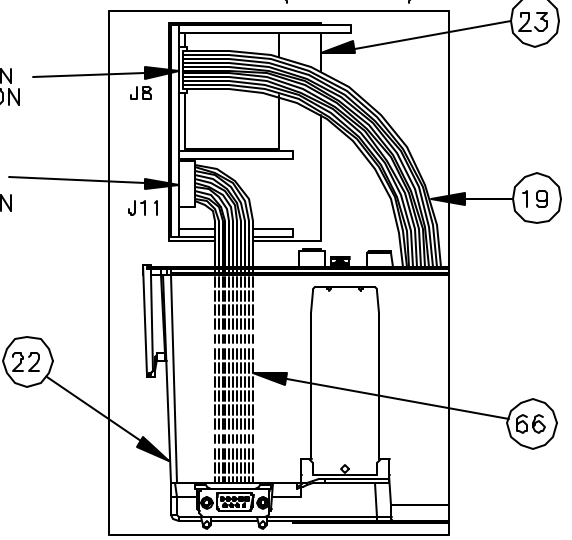


DETAIL 2



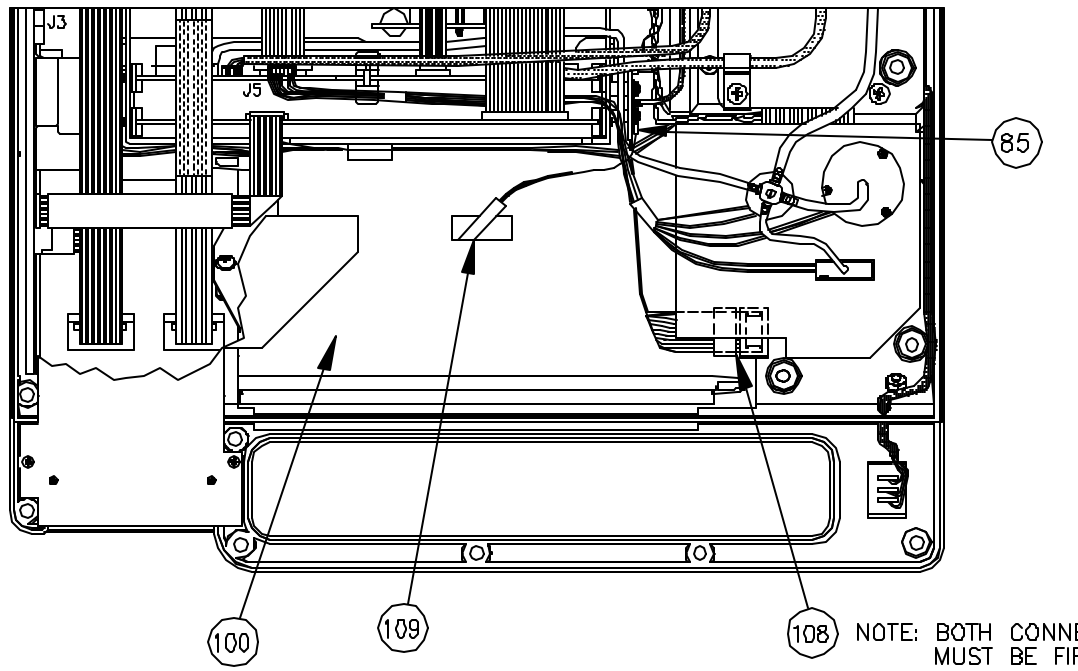


DETAIL 6
SIDE VIEW (EXPLODED)



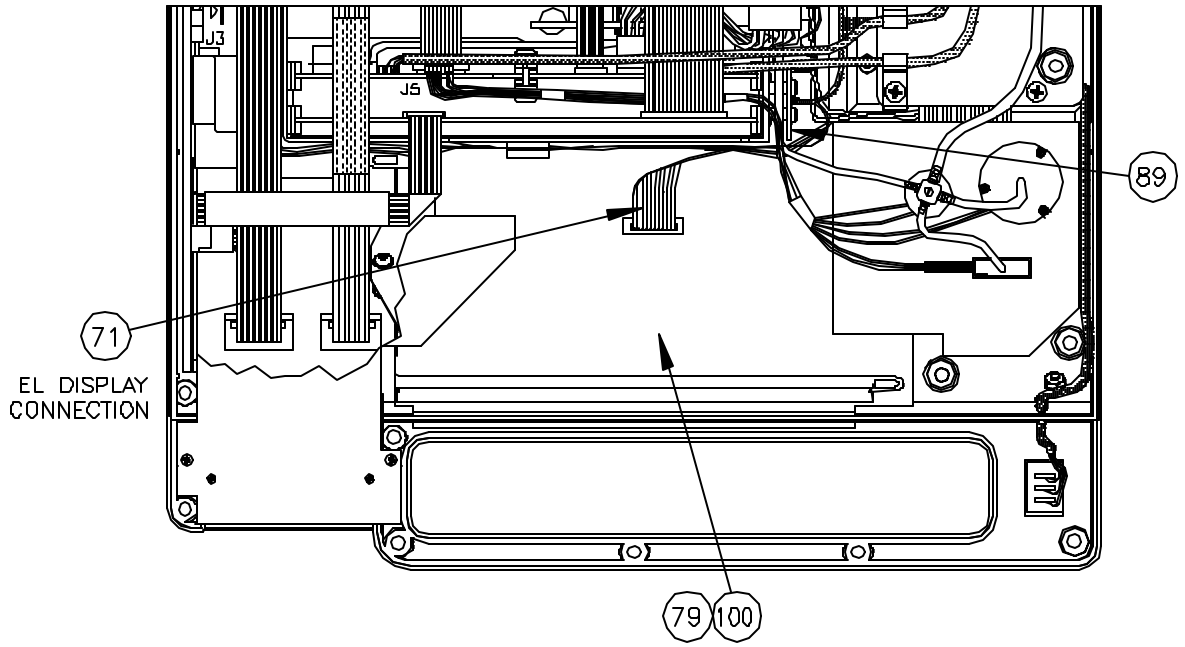
MRL medical research laboratories, inc.			
TITLE: PIC SERVICE DRAWING			
DRAWN M. HOWORKO	DATE 01/00	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 7 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

COLOR TFT DISPLAY OPTION (SHIELD IN PLACE)

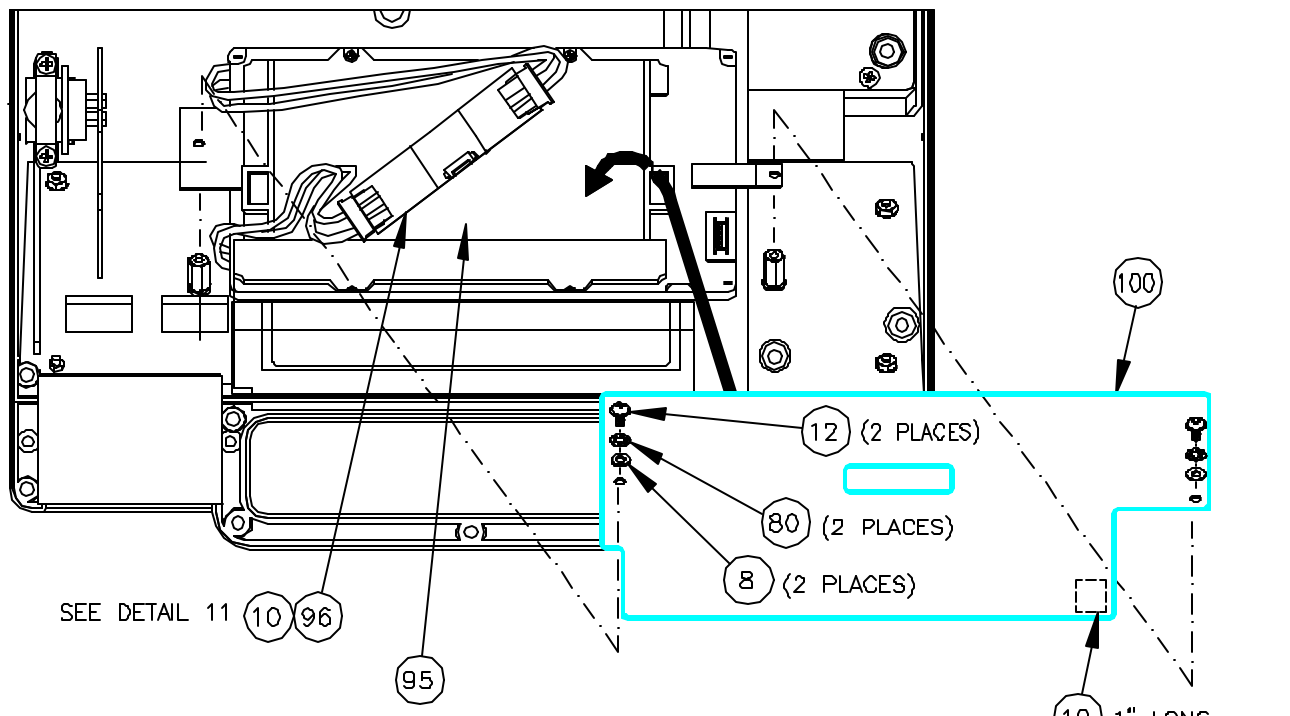


NOTE: BOTH CONNECTORS OF ITEM 108 MUST BE FIRMLY SEATED. SECURE FERRITE BEAD (OF ITEM 108) TO DISPLAY WITH TAPE (ITEM 114).

EL DISPLAY OPTION

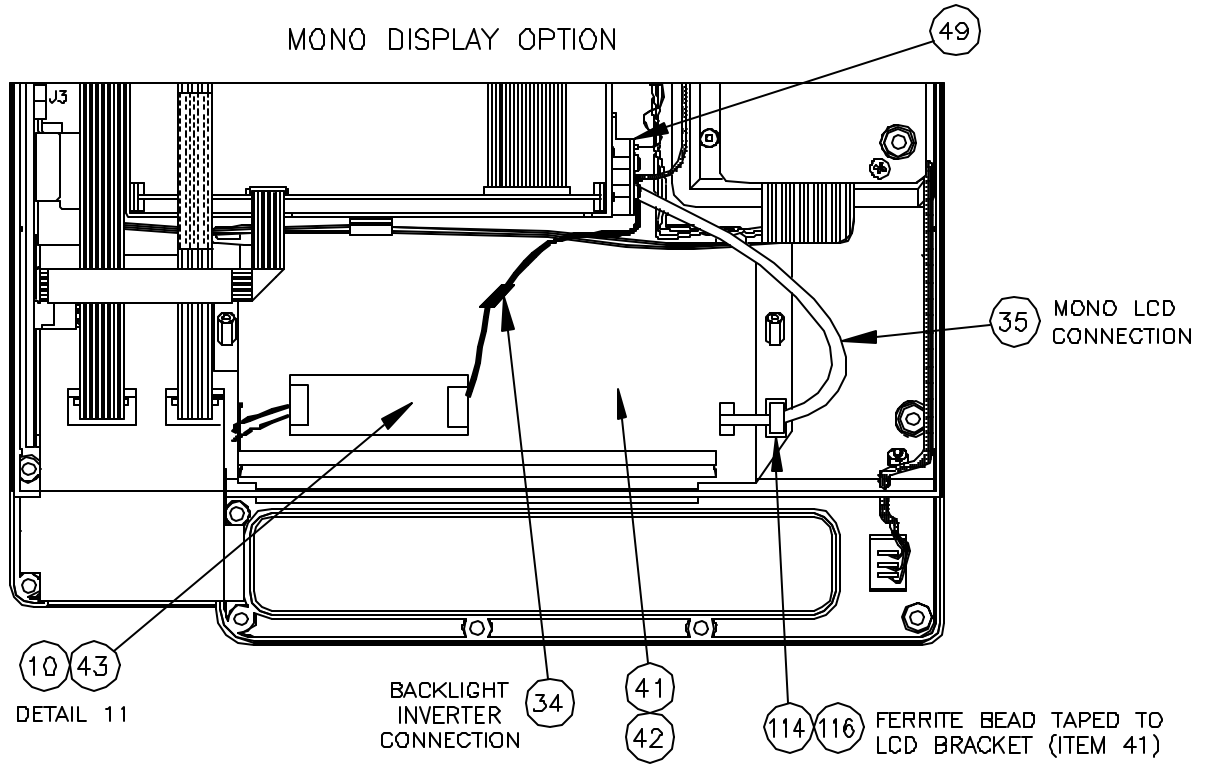


COLOR TFT DISPLAY OPTION (SHIELD REMOVED)

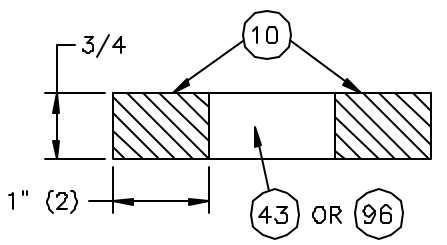


NOTE: WHEN INSTALLING ITEM 96, DO NOT FLEX THE CIRCUIT BOARD

MONO DISPLAY OPTION



DETAIL 11



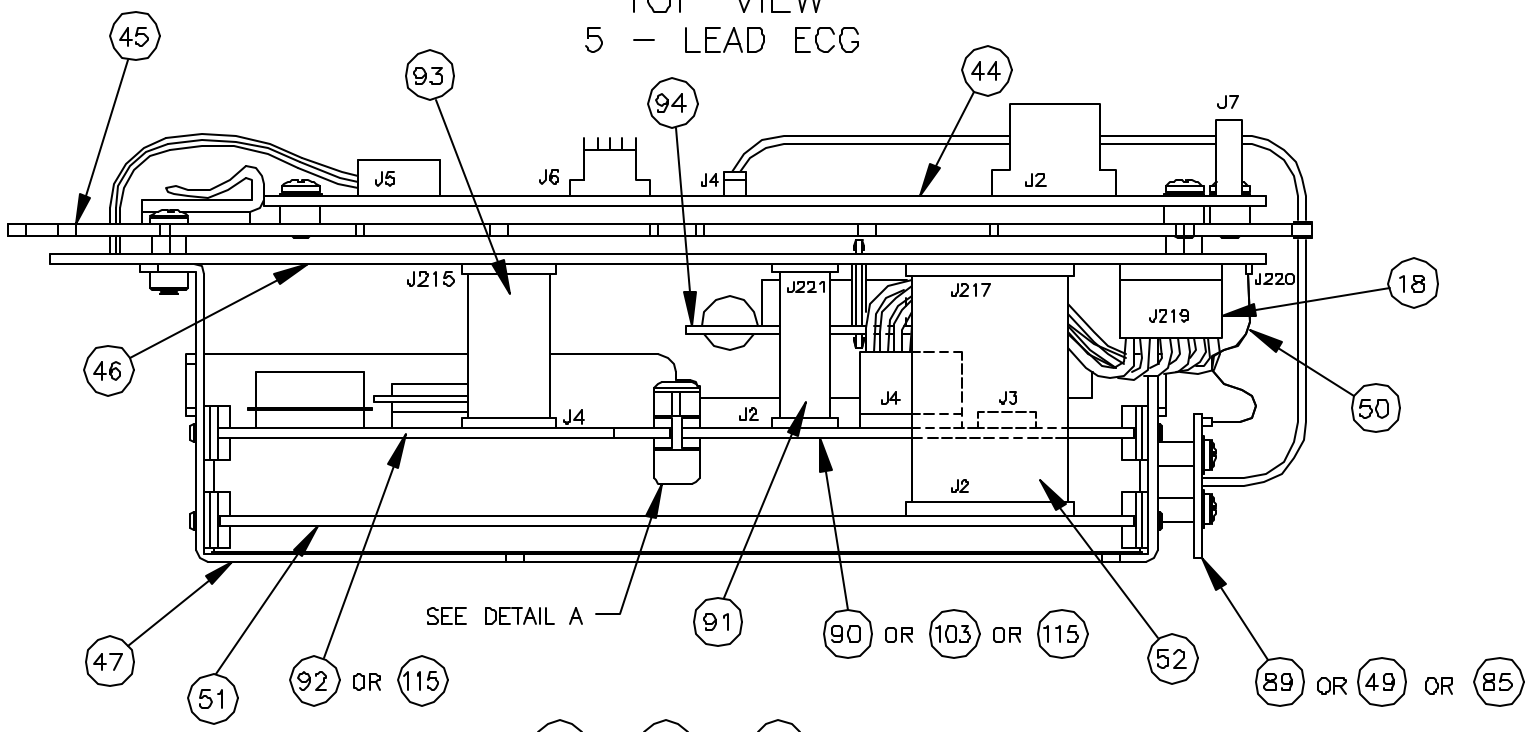
MRL medical research laboratories, inc.

TITLE PIC SERVICE DRAWING

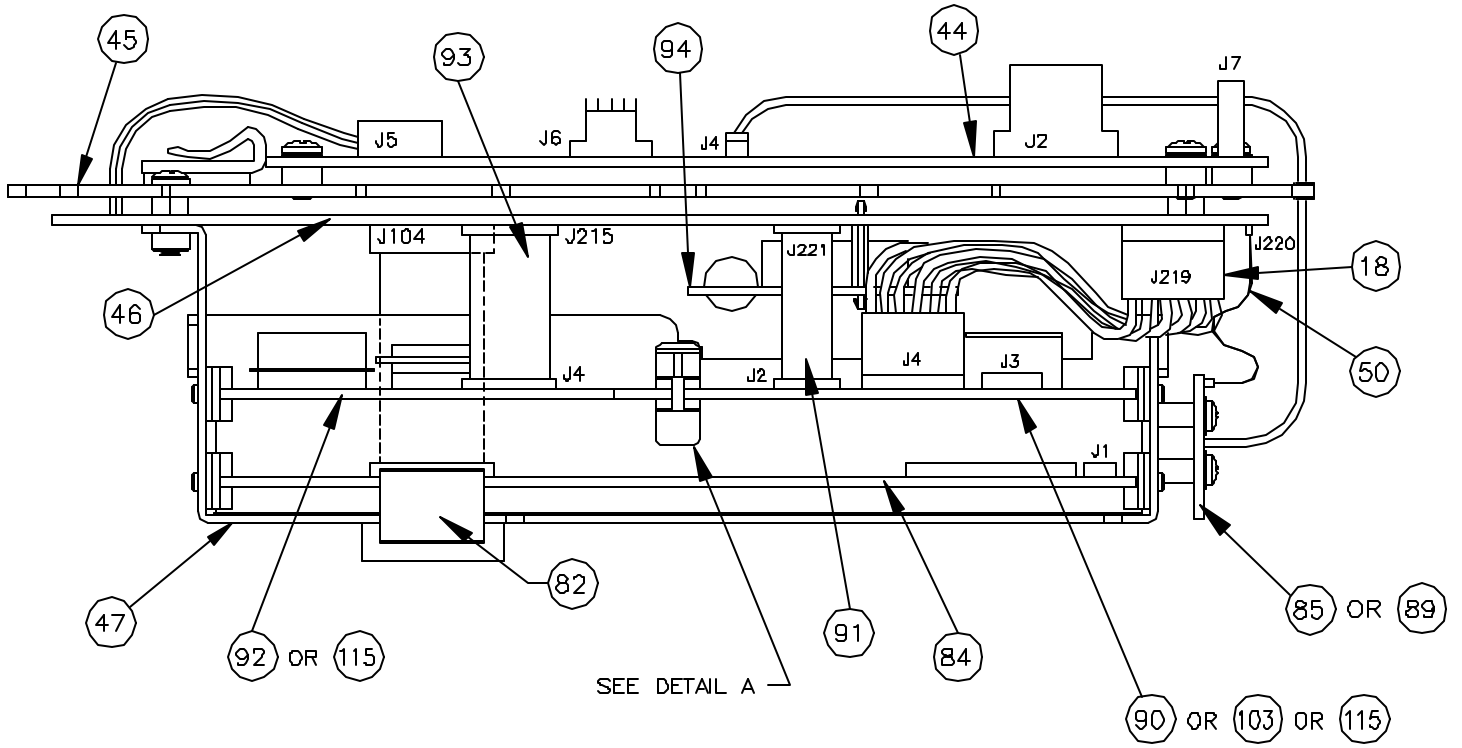
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 8 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

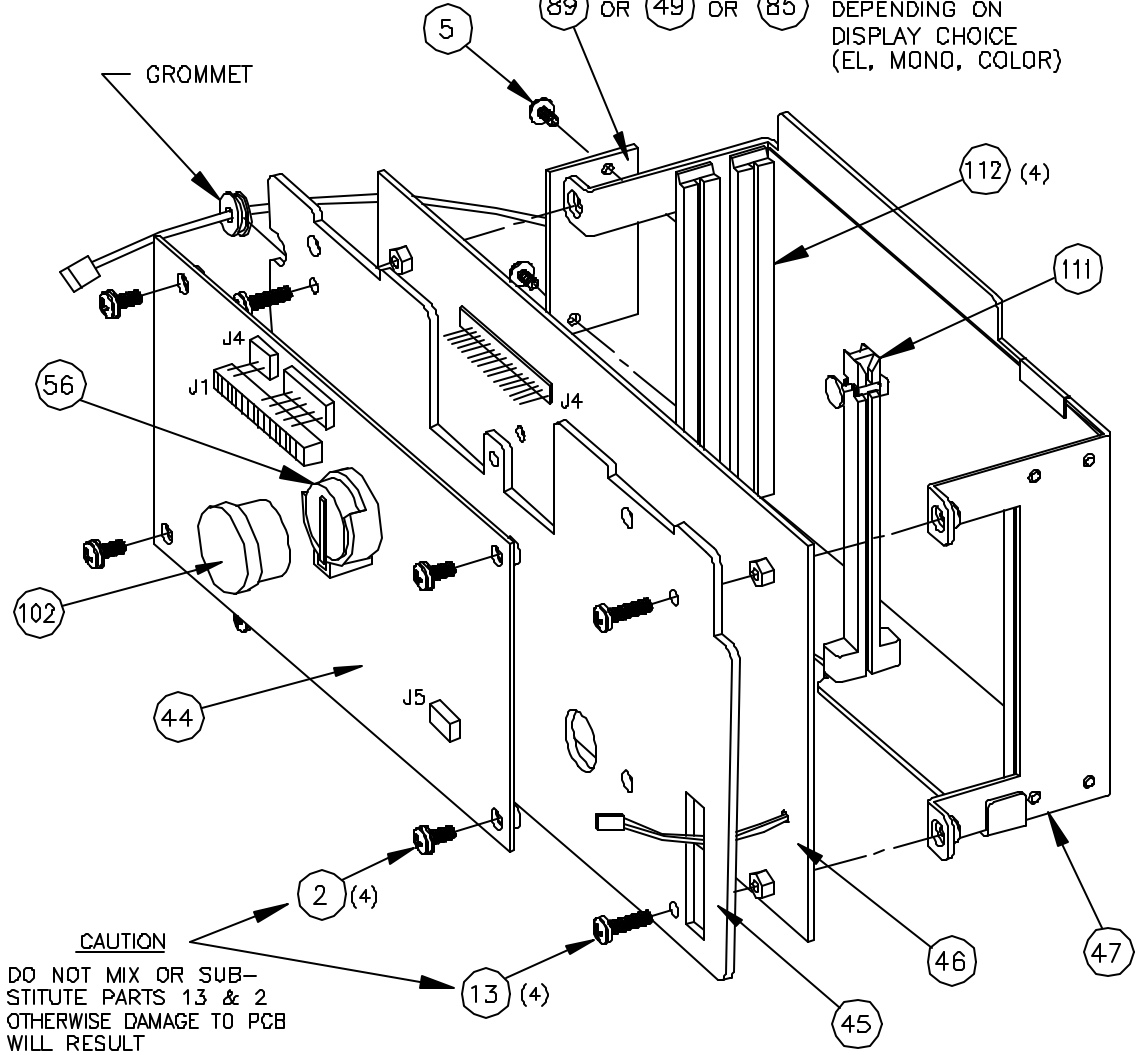
DRAWINGS INCLUDE ALL OPTIONS

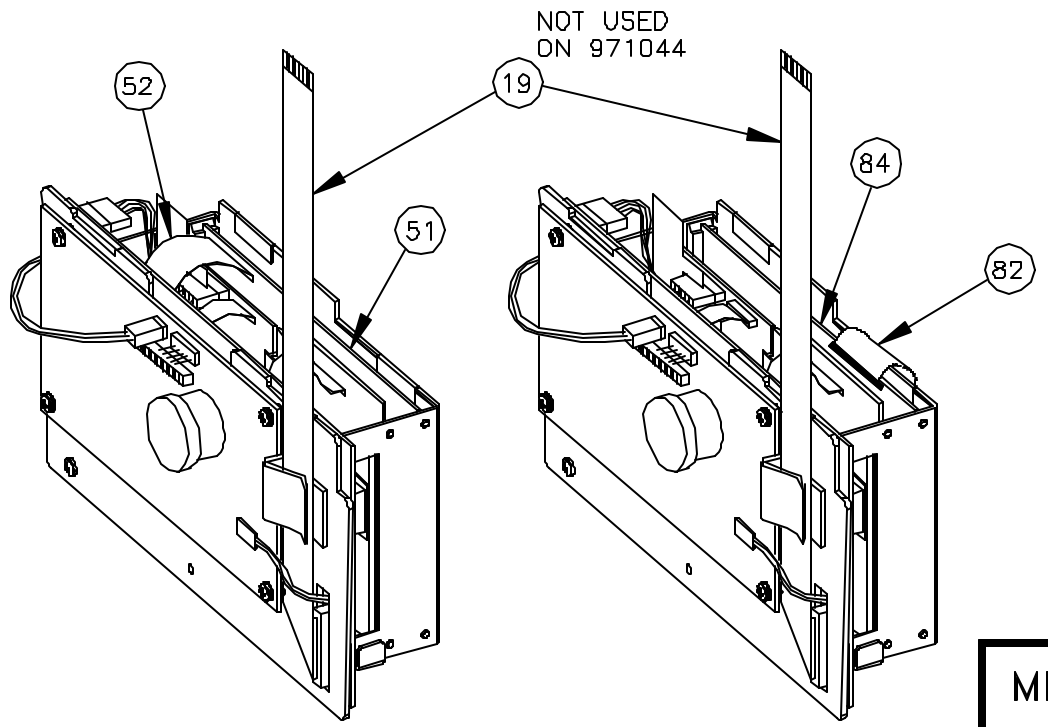
TOP VIEW
5 – LEAD ECG



TOP VIEW
12 – LEAD ECG OPTION

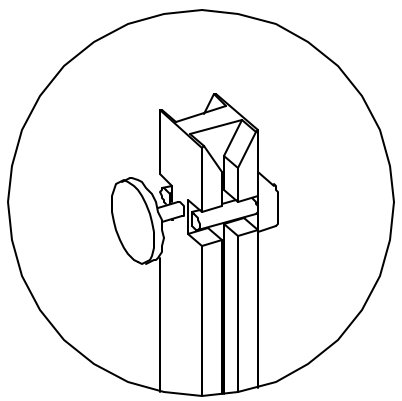






5–LEAD ECG

12–LEAD ECG



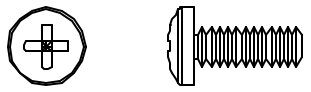
DETAIL A
SHOWN IN LOCKED POSITION

NOTE: CARD CAGE ASSEMBLY IS ITEM 48

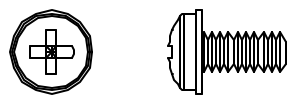
MRL medical research laboratories, inc.			
TITLE PIC SERVICE DRAWING			
DRAWN MIKE RIOS	DATE 7/98	PART NO. 991012	
CHK'D	DATE		
SCALE NTS		SHEET 9 OF 9	ISSUE D
FILE: F\DRAWINGS\ACAD\9\991012.DWG			

ISSUE	DESCRIPTION	INITIALS	DATE
A	ECO #2217 RELEASE	MH	01/00
B	ECO 2572 ADD IT 80,98,114,121	KDM	07/01

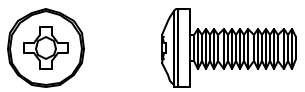
1 100614



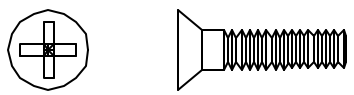
2 100733



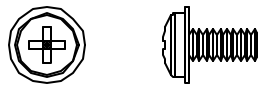
3 100735



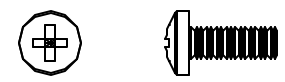
4 100667



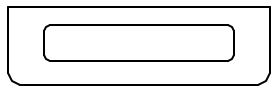
5 100465



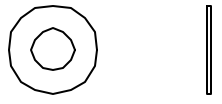
6 100417



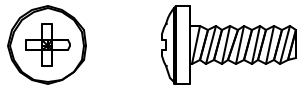
7 620414



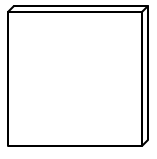
8 110009



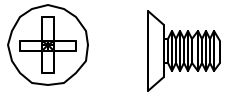
9 100727



10 800353

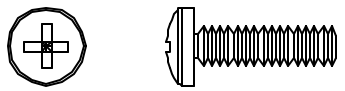


11 100608

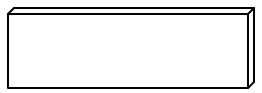


12 100407

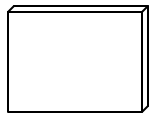
13 100618



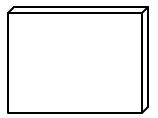
98 810149



114 810149



121 800397



ITEM	PART#	DESCRIPTION	QTY.
121	800397	TAPE ADHESIVE TRANSFER	3 in
114	810149	DBL COATED FOAM TAPE .062	1 in
98	800343	TAPE,COND FABRIC 1/2"WIDE	1.5 in
80	114003	WASHER #4 INTL TOOTH ZINC	2
13	100618	SCREW PPH 6-32 X 1/2	4
12	100407	SCREW PPH .004 40 X .500	2
11	100608	SCREW PFH 6-32 X1/4 UNDCT	1
10	800353	TAPE, DOUBLE SIDED, 1"	3 in
9	100727	SCREW 6 X 3/8" L	6
8	110009	WASHER .312. .148 .015	2
7	620414	SEAL, CHART RECORDER	1
6	100417	SCREW PPH .004 40 X	5
5	100465	SCR 4-40 X 25 PPH S	7
4	100667	SCRW PFH 6-32 X .750 ZINC	1
3	100735	SCREW, TRANSFER 6-32 X 3/8	4
2	100733	SCREW 6-32 X 5/16 PPH S	8
1	100614	SCREW PPH 6-32 X 3/8 DULL	9

MRL medical research laboratories, inc.

DIMENSIONAL TOLERANCES:
FRACTIONS ± 015
2 DECIMALS ± .010
3 DECIMALS ± .005
ANGLES

TITLE FASTENER KIT PIC

DRAWN M. HOWORKO | DATE 01/18/00 | APP'D | DATE

PART NO. 002110 | SHEET 1 OF 1 | ISSUE B

CHAPTER 10: SERVICE PART NUMBERS

This chapter provides information about specific PIC System service part numbers. The information is arranged in tables by item number and may include base part numbers, item part numbers, product name, and product descriptions.

Chapter Overview:

- *Item 21 – Bottom Assembly 10.2*
- *Item 22 – Top Enclosure Assembly 10.2*
- *Item 23 – Defibrillator Module 10.3*
- *Item 24 – Input Panel 10.4*
- *Item 46 – Motherboard 10.4*
- *Item 65 – Label Kit 10.5*
- *Item 105 – Fax Modem Board 10.5*

NOTE: Refer to Sheet 1 of the Assembly Drawings in Chapter 9 to associate a part number with an item number.

Refer to the part number of the unit and the explanation of the Part Numbering System in Chapter 2 to determine the appropriate replacement parts for your PIC, PIC Monitor, or MRL Lite system.

Item 21 - Bottom Assembly

Base Part Number	Description	Item 21 Part number
971039	MRL Lite	570620
971044	PIC Monitor	570620
All others	PIC	See below

Specify PIC part numbers as follows:

570606 - _____ _____ _____
Color Fax Data

Color: Y = Yellow, G = Gray

Fax: F = Fax Option (971019) installed

Data: R = Data Comm Package (971073) installed

Fax	Data Comm (RS-232)	Item 21 Part Number
N	N	570606-G or -Y
Y	N	570606-GF or-YF
N	Y	570606-GR or -YR
Y	Y	570606-GRF or -YRF

Item 22 - Top Enclosure Assembly

Base Part Number	Description	Item 22 Part Number
971039	MRL Lite	570619
971044	PIC Monitor	570614
971009	PIC, 5 lead, EL	570607
971013	PIC, 5 lead, Color TFT	570607
971026	PIC, 12 lead, EL	571616
971027	PIC, 12 lead, Color TFT	571616
971042	PIC, 5 lead, Mono LCD	570607
972013	PIC, 5 lead, Color TFT, Foreign	571607
972027	PIC, 12 lead, Color TFT, Foreign	571616

Item 23 - Defibrillator Module

MONOPHASIC-PIC, MRL Lite	
Base Part Number	**Item 23 Part Number**
971039	596327
971077	596327
971078	596327
971079	596327
971080	596327
971087	596327
971088	596327

BIPHASIC-PIC 2, MRL Lite 2	
Base Part Number	**Item 23 Part Number**
971081	597327
971082	597327
971083	597327
971084	597327
971085	597327
971086	597327
972039	597327

High Voltage BIPHASIC- PIC 2H, MRL Lite 2H	
Base Part Number	**Item 23 Part Number**
971081-2H	597405
971082-2H	597405
971083-2H	597405
971084-2H	597405
971085-2H	597405
971086-2H	597405
972039-2H	597405

Item 24 - Input Panel

Base Part Number	Description	Item 24 Part number
971039	MRL Lite	570617
All others	PIC, PIC Monitor	See below

Order the specified part number for Item 24 based on whether the SpO_2, NIBP/Temp, CO_2, or IBP options are installed in the unit. If your input panel has colored connectors, specify 570618.

NOTE: Y=Yes, N=No
Suffix G=Gray, Y=Yellow

SpO_2 MRL	SpO_2 Nellcor	NIBP/ Temp	CO_2	IBP	Item 24 Part Number
N	N	N	N	N	570618-G or Y
Y	-	N	-	-	570611-G or Y
Y	-	Y	-	-	570613-G or Y
-	Y	N	Y	N	570618-G2 or Y2
-	Y	Y	Y	Y	570618-G5 or Y5

Item 46 - Mother Board

Product	Item 46 Number	Re-order Number
Lite - 971039	591329	599329
PIC, PIC Monitor	590329	598329

NOTE: For a replacement Mother Board order 598329 or PIC, PIC 2, PIC 2H, and PIC Monitor. Order 599329 for MRL Lite. The new Mother Board will come pre-programmed with a unique serial number. Contact MRL Service Department (800-462-0777) for the option and upgrade codes for the new board.

Item 65 - Label Kit

Product	Item 65 Number
Lite - 971039	800974
PIC, PIC Monitor	800972

Item 105 - Fax Modem Board

The Fax Modem board part number is based on the Language Option in the product part number.

Language Option	Item 105 Part Number
E or M	590384
A	593384
All Others	595384